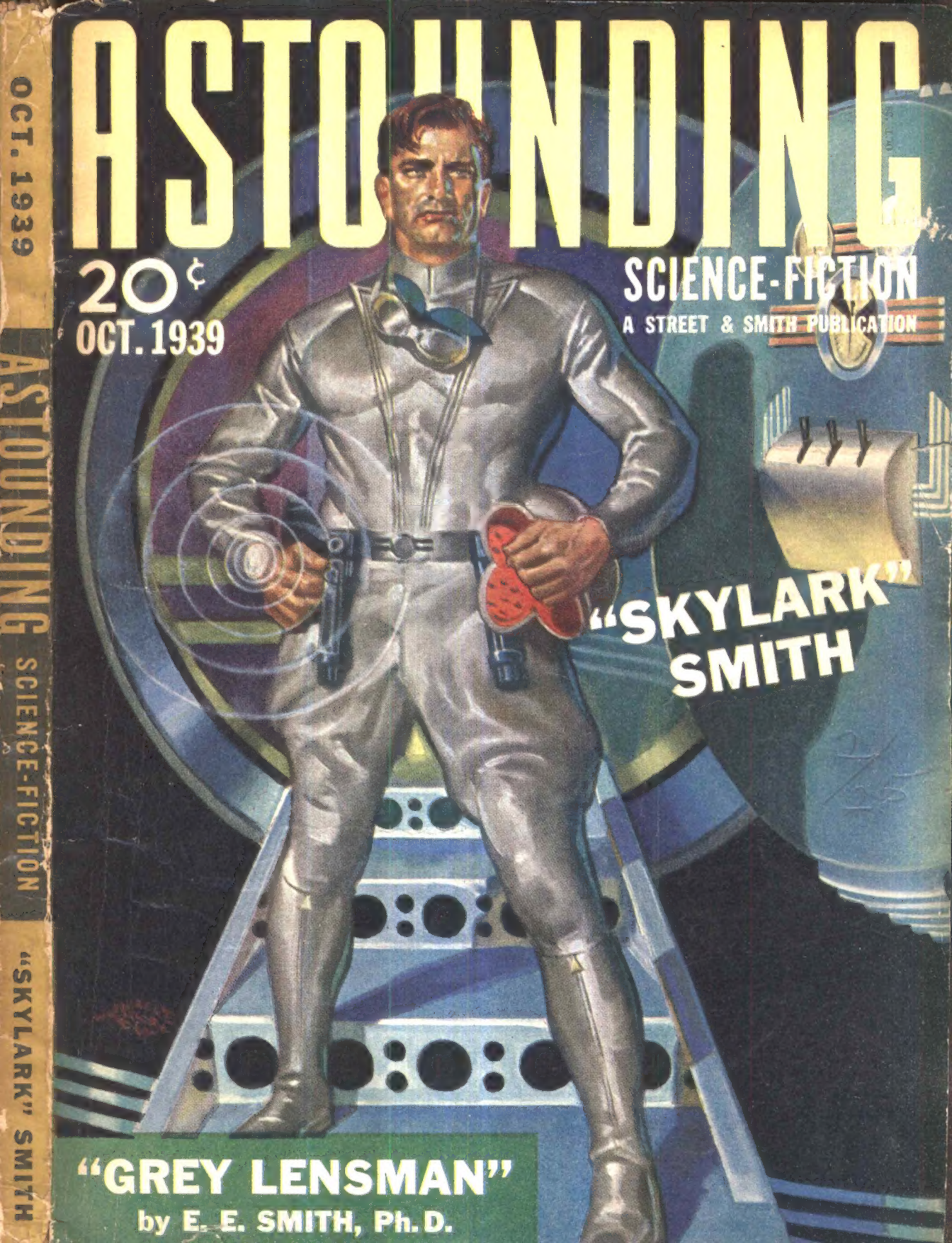
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"SKYLARK" SMITH
"GREY LENSMAN"
by E. E. SMITH, Ph.D.
OCT. 1939
ASTOUNDING SCIENCE-FICTION
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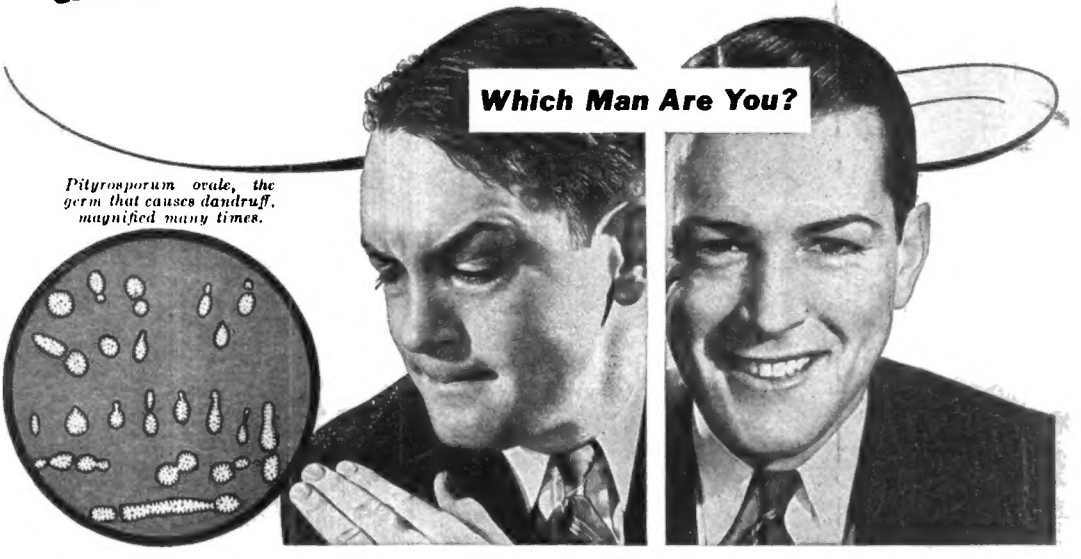
New, Easy, Scientific Home Method that GETS RID of DANDRUFF



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Listerine Antiseptic kills stubborn bottle-shaped germ (Pityrosporum ovale) which scientists proved causes dandruff. That's the secret of Listerine's amazing results . . . why many people have turned to it for real relief.

IF you have the slightest evidence of a dandruff condition, start now with the delightful twice-a-day treatment of Listerine with massage.

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Even after dandruff has disappeared, it is wise to guard against re-infection by occasional Listerine Antiseptic massages at regular intervals.

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MEN: Douse Listerine Antiseptic on the scalp *at least once a day.* **WOMEN:** Part the hair at various places, and apply Listerine Antiseptic right along the part with a medicine dropper, to avoid wetting the hair excessively.

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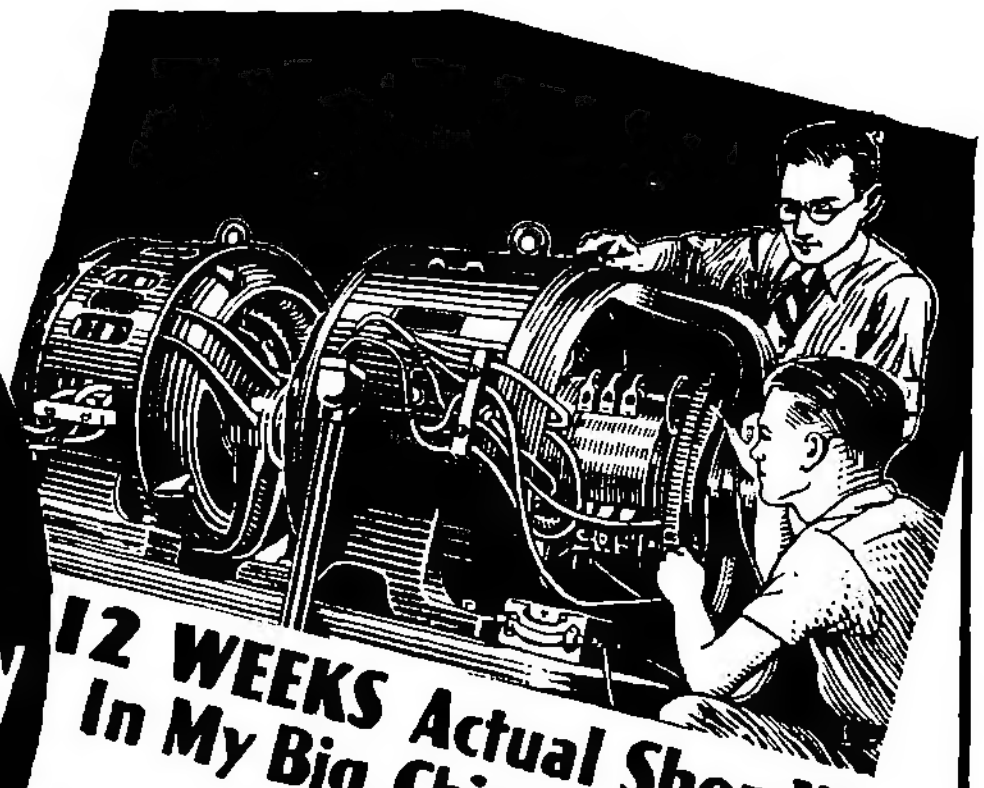

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H. C. LEWIS, President

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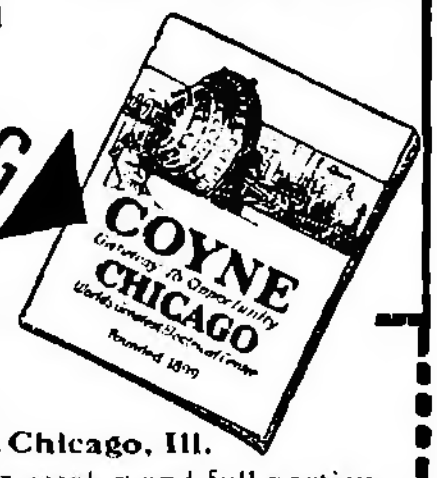

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CONTENTS OCTOBER, 1939 VOL. XXIV NO. 2

Illustrations by Kramer, Ley, Orban, Schneeman and Wesso

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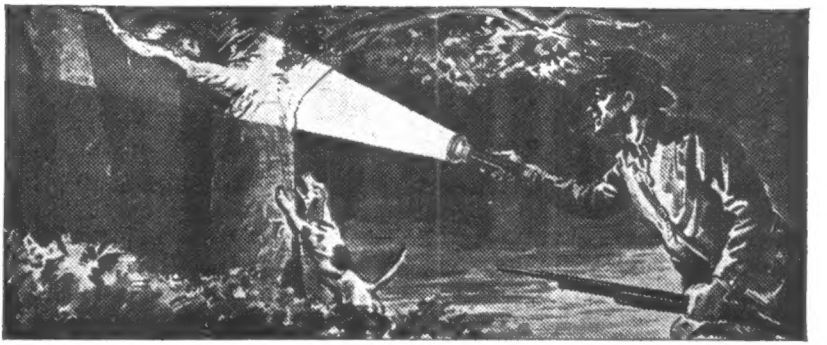
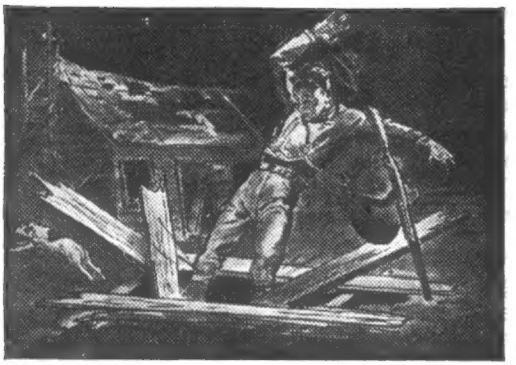
DEATH LEERS as Hunter Plummets into Pit!

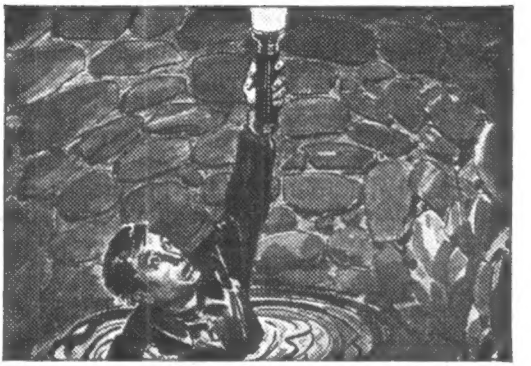
JAMES KIDWELL
Mt. Vernon, Texas



1 **"With my hound Jep,** I had bagged seven 'possums and was heading back for bed," writes James Kidwell. "I was cutting through the yard of an abandoned hilltop house, when the hound gave a frightened yelp and lit out for home.



2 **"I chuckled,** for superstitious folks down our way regard this as an ill omen. The next moment, rotten timbers crashed under me—I was falling!



3 **"I landed** at the bottom of an old well. It was impossible to scale the walls. I retrieved my flashlight from the icy water. She still worked.

4 **"My only chance** was to keep shooting the beam upward, hoping that it would be seen and that the batteries would last. My luck was good—two boys going home from town saw the strange flashes, and investigated. Those 'Eveready' *fresh* DATED batteries positively saved my life, as I would have died of exposure, if help hadn't come. You've got to be in the predicament I was before you really can appreciate the value of *fresh* batteries.

(*Signed*)

James Kidwell"

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INVITATION

This month begins the seventh year of Street & Smith's Astounding. Beginning this month also, as promised, is the first installment of Dr. E. E. Smith's "Gray Lensman"—which, I strongly suspect, will have been read before turning to this page. I most heartily regret that I cannot promise material of equal interest throughout the year unfortunately there is but one Dr. Smith, and he has a habit of taking two years to a story. But I can promise that the best material written in the science-fiction field during the coming twelve months will appear in Astounding.

Also, the articles which have been appearing in Astounding are steadily gaining in importance and interest. During the past year, several of our articles have been reprinted in straight-science magazines, both here and abroad, a record no other science-fiction magazine has established.

Something over a year ago Astounding ran an editorial, "Contest," pointing out that we run an "open" contest for new authors, both amateur and professional, every month, with prizes ranging up to $1,000.00, in the form of our regular manuscript buying. We pay out such "prizes" amounting to a good many hundreds of dollars every month of the year—and we emphatically want new, good talent. This is proven, I think, by the number of new, first-rank authors Astounding has developed—more, indeed, than all other similar magazines combined.

I want again to point out that open contest, and to add one more feature to it. Our articles have been valuable and thought-stimulating. (Look into Science Discussions this month to see the interesting and provocative row Willy Ley started with his "Space War"!) There are still many fields of science that we have not covered. Astounding has, I know, readers in practically every field of science, practicing, working research students in those lines. This is an invitation to those men who are not professional authors, but professional scientists, who know and feel the genuine excitement of that game of wits known as research, played against Nature, to submit material for our articles.

Particularly, I am interested in metallurgy, in biochemistry, and the physical chemistry of super-molecules such as are involved in plastics. Not having been exposed to some of the other frontiers of research, I can't name all; you who are working in other fields—send in what you feel is of interest.

I have heard it said that Nature will give a truthful answer to any intelligent question properly asked; research consists in determining what is the intelligent question. For instance, to ask how far away the rainbow is by measuring the distance the light from it has traveled, will get a meaningless answer of *minus* 93,000,000 miles. The question was not intelligently asked. The trick in getting the oracle of Nature to answer is to ask intelligent questions properly—which is nowhere near as simple as it sounds.

I—and I believe all of us—want to hear more about the new questions being asked, the new ways of asking—and the new answers. The frontiers of science today form the basis of science-fiction—Astounding wants both the straight science and the science-fiction. In the next year we want to present not necessarily more, but better, certainly, material in both fields.

The Editor.

HE THOUGHT HE WAS LICKED-THEN A TIP GOT BILL A GOOD JOB!

HERE'S PROOF THAT MY TRAINING PAYS

I'LL TRAIN YOU AT HOME *In Your Spare Time For A* GOOD RADIO JOB

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Radio broadcasting stations employ engineers, operators, station managers and pay well for trained men. Fixing Radio sets in spare time pays many $200 to $500 a year—full time jobs with Radio jobbers, manufacturers and dealers as much as $30, $50, $75 a week. Many Radio Experts open full or part time Radio sales and repair businesses. Radio manufacturers and jobbers employ testers, inspectors, foremen, engineers, servicemen, in good-pay jobs with opportunities for advancement. Automobile, police, aviation, commercial Radio, loudspeaker systems are newer fields offering good opportunities now and for the future. Television promises to open many good jobs soon. Men I trained have good jobs in these branches of Radio. Read how they got their jobs. Mail coupon.

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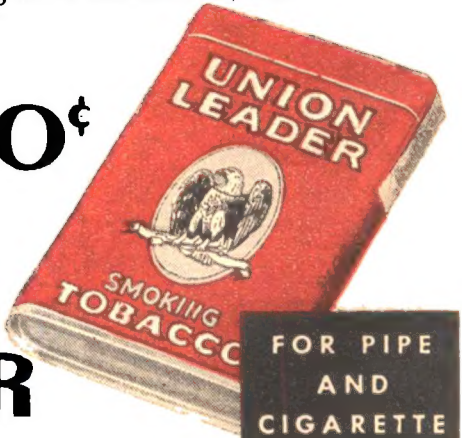
"Son, you've got the makin's of a man!"

IT does me good, Son, to see you takin' to Union Leader. *There's* a tobacco a man can tie to!

In my time, I s'pose I've tried a hundred brands, but I always come back grateful-like to Union Leader. For there's no substitute for what Union Leader puts into that big red tin:—flavor-filled, hill-grown Kentucky burley . . . aged to make it mellow-mild . . processed to rule out annoyin' tongue-bite.

Me—I like Union Leader burnin' cool in my pet pipe. But I can see how you young fellers enjoy those crisp, fresh cigarettes that Union Leader makes! Yes sir, and on a young man's pay, that 10¢ price is something to be thankful for, too!

10¢



FOR PIPE AND CIGARETTE

UNION LEADER

THE GREAT AMERICAN SMOKE

GRAY LENSMAN

By E. E. SMITH, Ph. D.

PROLOGUE

THIS is not, strictly speaking, a biography. It is not, it cannot be, comprehensive enough to be called that. Nor, since of necessity it must be limited, both in length and in scope, can it be called a history. It is, perhaps, best described as a record—the record of the activities of Galactic Co-ordinator Kimball Kinnison, Gray Lensman, of Tellus, during the Boskonian War.

Nevertheless this record, what there is of it, is in essence biographical; and the biographer of such a man as Kinnison has a peculiar task. In one way it is easy, in two others it is difficult in the extreme.

"Nuts!" he is wont to exclaim in answer to a direct question as to some particular event or situation. "Why in all the nine hells of Valeria are you still wasting time writing about *me?*" But eventually I get the data I need, and thus it is comparatively easy to make this work completely authentic, as far as the Gray Lensman himself is concerned.

It may be objected that I have recorded as facts certain minutiae which, considering what happened to the planet of the Eich and in the light of other happenings elsewhere, cannot be known so exactly by any living entity. This objection is untenable; as profound research upon every debatable point has shown conclusively that something very similar to, if not in fact identical with, each such detail must have occurred.

Of the two great difficulties, one lies in the selection of material. The story of Kimball Kinnison easily could—and really should—fill a dozen encyclopedic spools; it is a Galactic shame and an almost impossible undertaking to compress it into one two-hour tape. The other sticking point is the diversity of my audience. For in the First Galaxy alone there are millions of planets, peopled by races as divergent in mentality and in physique as they are far apart in space. Some races will read this chronicle from printed pages; some will see it; some will hear it; some will both see it and hear it; some, unable either to see or to hear, will receive it telepathically. Still others, in other Galaxies, will undoubtedly acquire it in fashions starkly incomprehensible to me, its compiler.

Numberless races of intelligent beings already know Kinnison well, since his fame has spread north, south, east, west, zenith and nadir, to the six points of the three-dimensional galactic-inductor compasses of two galaxies. On the other hand, many know him not at all. Many have never even heard of Tellus, nor of Sol, our parent sun; even though it was upon that proud planet of this, our Solarian System, , that the Galactic Patrol came into being. Indeed, it is inevitable that this biography will in days to come be of interest to races which, inhabiting planets not yet reached by the Cosmic Survey, have not even heard of the Galactic Patrol, to say nothing of knowing its origin and its history.

In view of the above inescapable facts, and after a great deal of thought and care, I have decided to write this Prologue, which will summarize very simply that which is already most widely known; namely, the happenings up to and including the first phase of the Boskonian War. Even that condensation, however, leaves me all too little space in which to do justice to the part that Kimball Kinnison played in enabling the civilization of the Galactic Council to triumph over the monstrous culture of Boskone.

With the understanding, then, that the more informed mentality may skip from here to Chapter I, I proceed.

SHOULD I begin with Arisia? That forbidding, forbidden planet whose inhabitants, having achieved sheerly unimaginable heights of philosophical and mental power, withdrew almost completely into themselves, leaving traces only in Galaxy-wide folk tales and legends of supermen and gods? Probably not. I should, it seems to me, begin with Earth's almost prehistoric bandits and gangsters, gentry who flourished in the days when space flight was mentioned only in fantastic fiction.

Know, then, that for ages law enforcement lagged behind law violation because the minions of the law were limited in their spheres of action, while

criminals were not. Thus, in the days following the invention of the automobile, State troopers could not cross State lines. Later, when what were then known as the "G-men" combined with the various State constabularies to form the National Police, they could not follow the stratosphere planes of the lawbreakers across national boundaries.

Still later, when interplanetary flight became commonplace, the Planetary Guards were at the same old disadvantage. They had no authority off their own worlds, while the public enemies flitted unhampered from planet to planet. And finally, with the development of the inertialess drive and the consequent traffic between hundreds of thousands of solar systems, crime became so rampant as to threaten the very foundations of civilization.

Then the Galactic Patrol came into being. At first it was a pitiful-enough organization. It was handicapped from within by the usual small, but utterly disastrous percentage of grafters and criminals: from without by the fact that there was then no emblem or credential which could not be counterfeited. No one could tell with certainty that the man in uniform was a Patrolman and not an outlaw in disguise.

The second difficulty was overcome first. One old-time Patrolman had heard of the Arisians. He visited their planet and—this should be a saga by itself—persuaded those Masters of Mentality that they should help right against wrong, at least to the extent of furnishing a positive means of identification. They did, and still do—The Lens.

Each being about to graduate as a Lensman is sent to Arisia; where, although the candidate does not then know it, a Lens—a lenticular jewel composed of thousands of tiny crystalloids—is built to match his individual life force. While no mind other than that of an Arisian can understand its functioning, thinking of the Lens as being synchronized with, or in exact resonance with the life principle—personality, ego, call it what you will—of its owner will give a rough idea of it. It is not really alive, as we understand the term. It is, however, endowed with a sort of pseudo-life, by virtue of which it gives off its strong, characteristically changing, polychromatic light as long as it is in circuit with the living mentality for which it was designed. It is inimitable, unforgettable. Anyone who has ever seen a Lens, or even a picture of one, will never forget it; nor will he ever be deceived by any possible counterfeit or imitation of it.

The Lens cannot be removed by anyone except its wearer without actual dismemberment of that wearer; it shines as long as its rightful owner wears it, and in the instant of its owner's death, it ceases forever to shine. And not only does a Lens refuse to shine if any impostor attempts to wear it—any Lens not in circuit with its owner kills in a space of minutes any other who touches it, so strongly does its pseudo-life interfere with any life to which it is not attuned.

Also by virtue of that pseudolife the Lens acts as a telepath through which its owner may communicate with any other intelligence, high or low; even though the other entity may possess no organs either of sight or of hearing, as we know these senses. The Lens has also many other highly important uses, which lack of space forbids even mentioning here.

HAVING the Lens, it was an easy matter for the Patrol to purify itself of its few unworthy members. Standards of entrance were raised higher and higher; and, as it became evident that it was to a man incorruptible, it was granted more and ever more authority.

Now its power is practically unlimited; the Lensman can follow the lawbreaker, wherever he may go. He can

commandeer any material or assistance, whenever and wherever required. The Lens is so respected throughout the Galactic Union that any wearer of it may at any time be called upon to act as judge, jury, and executioner. Wherever he goes, throughout the Universe of Civilization, he not only carries the law with him—he *is* the law.

How are these Lensmen chosen? An Earthman myself, and proud of the fact that Tellus was the cradle of Galactic Civilization, I will describe only how Tellurian Lensmen are selected. Upon other planets the methods and means vary widely; but the results are the same: Wherever he may be found or however monstrous he may appear, a Lensman is always a *Lensman.*

Each year one million boys are picked, by competitive examination, from all the eighteen-year-olds of Earth. During the first year of training, before any of them set foot inside Wentworth Hall, that number shrinks to less than fifty thousand. Then, for four years more, they are put through the most poignantly searching, the most pitilessly rigid process of elimination possible to develop, during the course of which every man who can be made to reveal any sign of unworthiness or of weakness is dropped. Of each class, only about a hundred win through to the Lens; but each of those few has proven repeatedly, to the cold verge of death itself, that he is in every sense fit to wear it.

Of those who drop out alive, most are dismissed from the Patrol. There are many splendid men, however, who for some reason not involving moral turpitude are not quite what a Lensman must be. These men make up the organization, from grease monkeys up to the highest commissioned officers below the rank of Lensman. This fact explains what is already so widely known: that the Galactic Patrol is the finest body of intelligent beings yet to serve under one banner.

But even Lensmen are not all alike; some are more richly endowed than others. Most Lensmen work more or less under direction; that is, they have headquarters and, at the completion of one investigation or project, are assigned to another by the port admiral. Occasionally, however, a Lensman shows himself to be of such outstanding ability, even for a Lensman, that he is given his Release. Technically, he is now an "Unattached Lensman"; in popular parlance he is a "Gray Lensman," from the color of the leather he wears.

THE RELEASE! The goal toward which all Lensmen strive, but which so relatively few attain, even after years of work! The Gray Lensman is as nearly absolutely free an agent as it is possible for any flesh-and-blood being to be. He is responsible to no one and to nothing save his own conscience. He is no longer of Earth, nor of the Solarian System, but of the Universe as a whole. He is no longer a cog in the immense machine of the Galactic Patrol; wherever he may go throughout the reaches of unbounded space, he *is* the Galactic Patrol:

He goes anywhere he pleases and does anything he pleases, for as long as he pleases. He takes what he wants, when he wants it, with or without giving reasons or anything except a thumb-printed credit slip in return—if he chooses to do so. He reports when, where, and to whom he pleases—or not, as he pleases. He has no headquarters, no address; he can be reached only through his Lens. He no longer gets even a formal salary; he takes that, too, as he goes, whatever he finds needful.

To the man on the street that would seem to be a condition of perfect bliss. It is not. All Lensmen strive mightily, for the Release, even though they realize dimly what it will mean—but only an Unattached Lensman really understands what a frightful, what a man-killing load

the Release brings with it. However, Gray Lensmen being what they must be, it is a load which they are glad and proud to bear.

Hence, to say that Kimball Kinnison ranked Number One in his graduating class is to say a great deal—but even more revealing of his quality is to add that he was the first to perceive that what was known as Boskonia was not merely an organization of outlaws and pirates, but was in fact a Galaxy-wide culture diametrically opposed in fundamental philosophy to that of Galactic Civilization. The most illuminating thing I can say of him in a few words, however, is this:

Of all the millions of entities who through the years had worn the symbol of the Lens, Kinnison was the first to perceive that the Arisians had endowed the Lens with powers theretofore undreamed of, powers which no brain without special training could either evoke or control. Thus, he was the first Lensman to return to Arisia for that advanced training; and during that instruction he learned why no other Lensman had been so trained before. It was such an ordeal that only a mind of power sufficient to perceive of itself the real need of such treatment could endure it without becoming starkly insane.

Shortly after Kinnison won his Lens, he was called to Prime Base by Port Admiral Haynes, the Patrol's chief of staff. There, in a room sealed against spy rays, an appalling situation was bared. Space piracy, always rife enough, had become an organized force; and, under the leadership of a half-mythical entity about whom nothing was known save the name "Boskone," had risen to such heights of power as to threaten seriously the Galactic Patrol itself. Indeed, in one respect, Boskonia was ahead of the Patrol, its scientists having developed a source of power vastly greater than any known to Galactic Civilization. It had fighting ships of a new and extraordinary type, from which even convoyed shipping was no longer safe. Being faster than the Patrol's fast cruisers, and more heavily armed than its heaviest battleships, they had been doing practically as they pleased in space.

For one particular purpose, the engineers of the Patrol had designed and built one ship—the *Brittania*. She was the fastest thing in space, but for offensive armament she had only one weapon, the "Q-gun." This depended upon chemical explosives, which, in warfare at least, had been obsolete for centuries. Nevertheless, Kinnison was put in command of the *Brittania* and was told to take her out, capture a pirate war vessel of late model, learn her secrets of power, and transmit the information to Prime Base with the least possible delay.

He was successful in finding and in defeating such a vessel. Peter van Buskirk led the storming party of Valerians—men of remote Earth-human ancestry, but of extraordinary size, strength and agility because of the enormous gravitation of generations of life on the planet Valeria—in wiping out those of the pirate crew not killed in the combat between the two vessels.

The *Brittania's* scientists secured the required data, but were unable to report immediately to Prime Base, as the pirates were blanketing all available channels of communication. Boskonian ships were gathering for the kill, and the crippled Patrol ship could neither run nor fight. Therefore each man was given a spool of tape bearing a complete record of everything that had occurred; and, after setting up a director-by-chance to make the empty ship pursue an unpredictable course in space, and after rigging bombs to explode her at the first touch of a ray, the Patrolmen paired off by lot and took to the lifeboats.

The erratic course of the cruiser

brought her near the lifeboat in which Kinnison and Van Buskirk were, and there the pirates attempted to stop her. The ensuing explosion was so violent that flying wreckage disabled practically the entire personnel of one of the attacking ships, which did not have time to go free—inertialess—before the crash. The two Patrolmen captured the pirate vessel and drove her toward Earth. They reached the solar system of Velantia before the Boskonians blocked them off, thus compelling them again to take to their lifeboat. They landed upon the planet Delgon, where they were rescued from a horde of Catlats by Worsel, a highly intelligent winged reptile, a native of the neighboring planet of Velantia.

By means of improvements upon Velantian thought-screens the three destroyed most of the Overlords of Delgon, a sadistic race of monsters who had been preying upon the other people of the system by sheer power of mind. Worsel then accompanied the two Patrolmen to Velantia, where all the resources of the planet were devoted to the preparation of defense against the expected attack of the Boskonians. Several other of the *Brittania's* lifeboats reached Velantia, guided by Worsel's mind working through Kinnison's mind and Lens.

Kinnison intercepted a message from Helmuth, who "spoke for Boskone," and traced his communicator beam, thus getting his first line upon Boskonia's Grand Base. The pirates attacked Velantia, and six of their vessels were captured. In these six ships, manned by Velantian crews and blanketing ether and subether against the pirates' own communicators, the Patrolmen again set out toward Earth and the Prime Base of the Galactic Patrol.

Then Kinnison's Bergenholm broke down. The Bergenholm, the generator of the force that neutralizes inertia—the *sine qua non* of interstellar speed. For, while any mass in the free condition can assume an almost unlimited velocity, inert matter cannot equal even that of light—the veriest crawl, as space speeds go. Also, there is no magic, no getting of something for nothing, in the operation of a Bergenholm. It takes power, plenty of power, to run one, and whenever one goes out, the ship dependent upon it is, to all intents and purposes, anchored in space.

Therefore the Patrolmen were forced to land upon Trenco—which, as almost everyone knows, is the planet upon which is produced thionite, perhaps the deadliest of all habit-forming drugs—for repairs.

Meanwhile Helmuth, the Boskonian, had deduced that it was a Lensman who had been giving him so much trouble. He had already connected the Lens with Arisia; therefore he set out for Arisia to find out for himself just what it was that made the Lens such a powerful thing. He discovered that he was no match at all for an Arisian. He was given terrific mental punishment, but was allowed to return to his Grand Base alive and sane; being informed that he was spared because his destruction would not be good for the budding Civilization to which Boskonian culture was opposed. He was told further that the Arisians had given Civilization the Lens; that by its intelligent use, Civilization should be able to conquer Boskone's alien, abhorrent culture; that if it could not learn to use the Lens, it was not yet ready to become a Civilization, and Boskonia would be allowed to flourish for a time.

After various adventures upon Trenco—a peculiar planet indeed—Kinnison secured a new Bergenholm and went on. This time he managed to reach Tellus, and, after a spectacular battle in the stratosphere with a blockading fleet of the enemy, got down to Prime Base with his precious data. There he first revealed his conviction that the Boskonians were not ordinary pirates, but in fact

composed a culture almost, if not quite, as strong as Civilization itself; and asked that certain scientists of the Patrol should try to develop a detector nullifier. He predicted a stalemate, and intimated that such a nullifier might well prove to be the deciding factor in the entire war.

By building ultrapowerful battleships, called "maulers," the Patrol gained a temporary advantage, but the stalemate soon ensued. Kinnison thought out a plan of action, in the pursuit of which he scouted a pirate base upon Aldebaran I. The personnel of this base, however, instead of being human or near-human beings, were Wheelmen, beings possessed of a sense of perception unknown to man. The Lensman was discovered before he could accomplish anything, and in the fight which followed he was very seriously wounded.

However, he managed to get back to his speedster and sent a thought to Port Admiral Haynes, who forthwith sent ships to his aid. In the hospital, Chief Surgeon Lacy put him together without the use of artificial members; and, during a long and quarrelsome convalescence, Nurse Clarrissa MacDougall held him together.

As soon as he could leave the hospital he went to Arisia in the hope that he might be permitted to take advanced training—an unheard-of idea. Much to his surprise, he learned that he had been expected to return for exactly such training. Getting it almost killed him, but he emerged from the ordeal infinitely stronger of mind than any man had ever been before; and possessed of a new sense of perception as well—a sense somewhat analogous to sight, but of vastly greater power, depth, and scope, and not dependent upon light, a sense only vaguely forecast by ancient experiments with clairvoyance.

After trying out his new mental equipment by solving a murder mystery upon Radelix, he succeeded in entering an enemy base upon Boyssia II. There he took over the mind of the communications officer and waited for the opportunity of getting the second, all-important line upon Boskonia's Grand Base. An enemy ship of this base captured a hospital ship of the Patrol and brought it in. Nurse MacDougall, head nurse of the captured ship, working under Kinnison's instructions, stirred up trouble which soon became mutiny. Helmuth, from Grand Base, took a hand, thus enabling Kinnison to get his second line.

The hospital ship, undetectable by virtue of the Lensman's nullifier, escaped from Boyssia II and headed for Earth at full blast. Kinnison, convinced that Helmuth was really Boskone himself, found that the intersection of his two lines—and therefore the pirates' Grand Base—lay in a star cluster AG 257-4736, well outside the Galaxy. Pausing only long enough to destroy the Wheelmen of Aldebaran I, the project in which his first attempt had failed so dismally, he set out to investigate Helmuth's headquarters. He found a stronghold impregnable to any massed attack the Patrol could throw against it, manned by beings each wearing a thought-screen. His sense of perception was suddenly cut off—the pirates had thrown a thought-screen around the entire planet. He then returned to Prime Base, deciding en route that boring from within was the only possible way in which that stupendous fortress could be taken.

In consultation with Port Admiral Haynes, the zero hour was set, at which time the massed Grand Fleet of Patrol was to begin raying Helmuth's base with every projector that could be brought to bear.

Pursuant to his plan, Kinnison again visited Trenco, where the Patrol forces extracted for him fifty kilograms of thionite, the noxious drug which, in microgram inhalations, makes the ad-

dict experience all the sensations of doing whatever it is that he wishes most ardently to do. The larger the dose, the more intense the sensations; the slightest overdose resulting in an ecstatic death. Thence to Helmuth's planet; where, finding a dog whose brain was unshielded, he let himself into the central dome. Here, just before the zero minute, he released his thionite into the air stream, thus wiping out all the pirate personnel except Helmuth, who,

Through inter-Galactic space Helmuth's thought drove.
"You said the defenses were adequate!"
"I said they seemed adequate," said the Eichlan coldly.

in his inner sanctum, could not be affected.

The Grand Fleet of the Patrol attacked, but Helmuth would not leave his retreat, even to try to save his Base. Therefore Kinnison would have to go in after him. Poised in the air of Helmuth's inner sphere there was an enigmatic, sparkling ball of force which the Lensman could not understand, and of which he was in consequence extremely suspicious.

But the storming of that quadruply-defended inner stronghold was precisely the task for which Kinnison's new and ultracumbersome armor had been designed; and in the Gray Lensman went.

I.

AMONG the world-girdling fortifications of a planet distant indeed from star cluster AG 257-4736 there squatted sullenly a fortress quite similar to Helmuth's own. Indeed, in some respects it was even superior to the base of him who spoke for Boskone. It was larger and stronger. Instead of one dome, it had many. It was dark and cold withal, for its occupants had practically nothing in common with humanity save the possession of high intelligence.

In the central sphere of one of the domes there sparkled several of the peculiarly radiant globes whose counterpart had given Kinnison so seriously to think, and near them there crouched or huddled or lay at ease a many-tentacled creature indescribable to man. It was not exactly like an octopus. Though spiny, it did not resemble at all closely a sea-cucumber. Nor, although it was scaly and toothy and wingy, was it, save in the vaguest possible way, similar to a lizard, a sea serpent, or a vulture. Such a description by negatives is, of course, pitifully inadequate; but, unfortunately, it is the best that can be done.

The entire attention of this being was focused within one of the globes, the obscure mechanism of which was relaying to his sense of perception from Helmuth's globe and mind a clear picture of everything which was happening within Grand Base. The corpse-littered dome was clear to his sight; he knew that the Patrol was attacking from without; knew that that ubiquitous Lensman, who had already unmanned the citadel, was about to attack from within.

"You have erred seriously," the entity was thinking coldly, emotionlessly, into the globe, "in not deducing until after it was too late to save your base that the Lensman had perfected a nullifier of sub-ethereal detection. Your contention that I am equally culpable is, I think, untenable. It was your problem, not mine; I had, and still have, other things to concern me. Your base is of course lost; whether or not you yourself survive will depend entirely upon the adequacy of your protective devices."

"But, Eichlan, you yourself pronounced them adequate!"

There followed an interval of silence, as though those conferring were separated by such a gulf of space that even thought, with its immeasurable velocity of propagation, required finite time to traverse it.

"Pardon me—I said that they *seemed* adequate."

"If I survive—or, rather, after I have destroyed this Lensman—what are your orders?" Another interval.

"Go to the nearest communicator and concentrate our forces; half of them to engage this Patrol fleet, the remainder to wipe out all the life of Sol III. I have not tried to give those orders direct, since all the beams are keyed to your board and, even if I could reach them, no commander in that Galaxy knows that I speak for Boskone. After you have done that, report to me here."

"Instructions received and understood. Helmuth, ending message."

"Set your controls as instructed. I will observe and record. Prepare your-

self, the Lensman comes. Eichlan, speaking for Boskone, ending message."

The Lensman rushed. Even before he crashed the pirate's screens his own defensive zone flamed white in the beam of semiportable projectors, and through that blaze came tearing the metallic slugs of a high-caliber machine rifle. But the Lensman's screens were almost those of a battleship, his armor relatively as strong; he had at his command projectors scarcely inferior to those opposing his advance. Therefore, with every faculty of his newly enlarged mind concentrated upon that thought-screened, armored head behind the bellowing gun and the flaring projectors, Kinnison held his line and forged ahead.

ATTENTIVE as he was to Helmuth's thought-screens, the Patrolman was ready when it weakened slightly and a thought began to seep through, directed at that peculiar ball of force. He blanketed it savagely, before it could even begin to take form, and attacked the screen so viciously that the Boskonian had either to restore full coverage instantly or else die there and then.

Kinnison feared that force-ball no longer. He still did not know what it was; but he had learned that, whatever its nature might be, it was operated or controlled by thought. Therefore it was and would remain harmless. If the pirate chief softened his screen enough to emit a thought he would never think again.

Doggedly the Lensman drove in, closer and closer. Magnetic clamps locked and held. Two steel-clad, warring figures rolled into the line of fire of the ravening automatic rifle. Kinnison's armor, designed and tested to withstand even heavier stuff, held; wherefore he came through that storm of metal unscathed. Helmuth's, however, even though stronger far than the ordinary personal armor of space, failed; and thus the Boskonian died.

Blasting himself upright, the Patrolman shot across the inner dome to the control panel and paused, momentarily baffled. He could not throw the switches controlling the defensive screens of the gigantic outer dome! His armor, designed for the ultimate of defensive strength, could not and did not bear any of the small and delicate external mechanisms so characteristic of the ordinary spacesuit. To leave his personal tank at that time and in that environment was unthinkable; yet he was fast running out of time. A scant fifteen seconds was all that remained before zero, the moment at which the hellish output of every watt generable by the massed fleet of the Galactic Patrol would be hurled against those screens in their furiously raging destructive might. To release the screens after that zero moment would mean his own death, instantaneous and inevitable.

Nevertheless, he could open those circuits—the conservation of Boskonian property meant nothing to him. He flipped on his own projector and flashed its beam briefly across the banked panels in front of him. Insulation burst into flame, fairly exploding in its haste to disintegrate; copper and silver ran in brilliant streams or puffed away in clouds of sparkling vapor: high-tension arcs ripped, crashed, and cracked among the writhing, dripping, flaring bus-bar. The shorts burned themselves clear or blew their fuses, every circuit opened, every Boskonian defense came down; and then, and only then, could Kinnison get into communication with his friends.

"Haynes!" he thought crisply into his Lens. "Kinnison calling!"

"Haynes acknowledging!" a thought instantly snapped back. "Congrat—"

"Hold it! We're not done yet! Have every ship in the Fleet go free at once. Have them all, except yours, put out full-coverage screens, so that they can't look at or think into this Base."

A moment passed. "Done!"

"Don't come in any closer—I'm on my way out there to you. Have your ship block every band except your personal frequency, which you and I are now on, and caution all Lensmen aboard with you to stay off that channel until further notice. Now as to you, personally, I don't like to seem to be giving orders to the Admiral of the Fleet, but it may be quite essential that you concentrate upon me, and think of nothing else, for the next few minutes."

"Right! I don't mind taking orders from *you*."

"QX. Now we can take things a bit easier." Kinnison had so arranged matters that no one except himself could think into that stronghold, and he himself would not. He would not think into that tantalizing enigma, nor toward it, nor even of it, until he was completely ready to do so. And how many persons, I wonder, really realize just how much of a feat that was? Realize the sort of mental training that required?

"How many gamma-zeta tracers can you put out, chief?" Kinnison asked then, more conversationally.

A brief consultation; then, "Ten in regular use. By tuning in all our spares we can put out sixty."

"At two diameters' distance forty-eight fields will surround this planet at one hundred percent overlap. Please have that many set that way. Of the other twelve, set three to go well outside the first sphere—say at four diameters out—covering the line from this planet to Lundmark's Nebula. Set the last nine to be thrown out as far as you can read them accurately to only the first decimal on your screens, centering on the same line. Not much overlap is necessary on these backing fields—bare contact is enough. Release nothing, of course, until I get there. And while the boys are setting things up, you might go inert—it's safe enough now—so that I can match your intrinsic velocity and come aboard."

THERE FOLLOWED the maneuvering necessary for one inert body to approach another in space, then Kinnison's incredible housing of steel was hauled into the airlock by means of space lines attached to magnetic clamps. The outer door of the lock closed behind him, the inner one opened, and the Lensman entered the flagship.

First to the armory, where he clambered stiffly out of his small battleship and gave orders concerning its storage. Then to the control room, stretching and bending hugely as he went, in vast relief at his freedom from the narrow and irksome confinement which he had endured so long.

Of all the men in that control room, only two knew Kinnison personally. All knew of him, however, and as the tall gray-clad figure entered there was a loud, quick cheer.

"Hi, fellows—thanks." Kinnison waved a salute to the room as a whole. "Hi, Port Admiral! Hi, Commandant!" He saluted Haynes and von Hohendorff as perfunctorily, and greeted them as casually, as though he had last seen them an hour, instead of ten weeks, before; as though the intervening time had been spent in the veriest idleness, instead of in the fashion in which it actually had been spent.

Old von Hohendorff greeted his erstwhile pupil cordially enough, but: "Out with it!" Haynes demanded. "What did you do? How did you do it? What does all this confounded rigmarole mean? Tell us all about it—all you can, I mean," he added, hastily.

"There's no need of secrecy now, I think," and in flashing thoughts the Gray Lensman went on to describe everything that had happened.

"So you see," he concluded, "I don't really *know* anything. It's all surmise, suspicion, and deduction. It may be that nothing at all will happen: in which case these precautions, while they will have been wasted effort, will have done

us no harm. In case something *does* happen, however—and I'll bet all the tea in China that something will—we'll be ready for it."

"But if what you are beginning to suspect is really true, it means that Boskonia is inter-Galactic in scope—wider spread even than the Patrol!"

"Probably, but not necessarily—it may mean only that they have bases further outside. And remember that I'm arguing on a mighty slim thread of evidence. That screen was hard and tight, and I couldn't touch the external beam—if there was one—at all. I got just part of a thought, here and there. However, the thought was 'that' galaxy; not just 'galaxy,' or 'this' or 'the' galaxy—and why think that way if the guy was already in this galaxy?"

"But nobody has ever— But skip it for now—the boys are ready for you. Take over!"

"QX. First we'll go free again. Don't think much, if any, of the stuff can come out here, but no use taking chances. Cut your screens. Now, all you gamma-zeta men, throw out your fields, and if any of you get a puncture, or even a flash, measure its position. You recording observers, step your scanners up to fifty thousand. QX?"

"QX!" the observers and recorders reported, almost as one, and the Gray Lensman sat down at a plate.

HIS MIND, free at last to make the investigation from which it had been so long and so sternly barred, flew down into and through the dome, to and into that cryptic globe so tantalizingly poised in the air of the Center.

The reaction was practically instantaneous; so rapid that any ordinary mind could have perceived nothing at all; so rapid that even Kinnison's consciousness recorded only a confusedly blurred impression. But he did see something: in that fleeting millionth of a second he sensed a powerful, malignant mental force; a force backing multiplex scanners and sub-ethereal stress-fields interlocked in peculiarly unidentifiable patterns.

For that ball was, as Kinnison had more than suspected, a potent agency indeed. It was, as he had thought that it must be, a communicator; but it was far more than that. Ordinarily harmless enough, it could be so set as to become an infernal machine at the vibrations of any thought not in a certain coded sequence; and Helmuth had so set it.

Therefore at the touch of the Patrolman's thought it exploded: liberating instantaneously the unimaginable forces with which it was charged. More, it sent out waves which, attuned to detonating receivers, touched off strategically placed stores of duodecaplylatomate. "Duodec," that concentrated essence of atomic violence than which science has even yet failed to develop a more devastating!

"Hell's—jingling—bells!" Port Admiral Haynes grunted in stunned amazement, then subsided into silence, eyes riveted upon his plate; for to the human eye dome, fortress, and planet had disappeared in one cataclysmically incandescent sphere of flame.

But the observers of the Galactic Patrol did not depend upon eyesight alone. Their scanners had been working at ultrafast speed; and, as soon as it became clear that none of the ships of the Fleet had been endangered, Kinnison asked that certain of the spools be run into a visitank at normal tempo.

There, slowed to a speed at which the eye could clearly discern sequences of events, the two old Lensmen and the young one studied with care the three-dimensional pictures of what had happened; pictures taken from points of projection close to and even within the doomed structure itself.

Deliberately, the ball of force opened up, followed an inappreciable instant later by the secondary centers of detona-

tion; all expanding magically into spherical volumes of blindingly brilliant annihilation. There were as yet no flying fragments: no inert fragment *can* fly from duodec in the first few instants of its detonation. For the detonation of duodec is propagated at the velocity of light, so that the entire mass disintegrates in a period of time to be measured only in fractional trillionths of a second. Its detonation pressure and temperature have never been measured save indirectly, since nothing will hold it except a Q-type helix of pure force. And even those helices, which perforce must be practically open at both ends, have to be designed and powered to withstand pressures and temperatures obtaining only in the cores of suns.

Imagine, if you can, what would happen if some fifty thousand metric tons of material from the innermost core of Sirius B were to be taken to Grand Base, separated into twenty-five packages, each package placed at a strategic point, and all restraint instantaneously removed. What would have happened then, was what actually *was* happening!

As has been said, for moments nothing moved except the ever-expanding spheres of destruction. Nothing *could* move—the inertia of matter itself held it in place until it was too late—everything close to those centers of action simply flared into turgid incandescence and added its contribution to the already hellish whole.

As the spheres expanded, their temperatures and pressures decreased and the action became somewhat less violent. Matter no longer simply disappeared. Instead, plates and girders, even gigantic structural members, bent, buckled, and crumbled. Walls blew outward and upward. Huge chunks of metal and of masonry, many with fused and dripping edges, began to fly in all directions.

And not only, or principally, upward was directed the force of those inconceivable explosions. Downward the effect was, if possible, even more catastrophic, since conditions there approximated closely the oft-argued meeting between the irresistible force and the immovable object. The planet was to all intents and purposes immovable, the duodec to the same degree irresistible. The result was that the entire planet was momentarily blown apart. A vast chasm was blasted deep into its interior, and, gravity temporarily overcome, stupendous cracks and fissures began to yawn. Then, as the pressure decreased, the core-stuff of the planet became molten and began to wreak its volcanic havoc.

Gravity, once more master of the situation, took hold. The cracks and chasms closed, extruding uncounted cubic miles of fiery lava and metal. The entire world shivered and shuddered in a Gargantuan cosmic ague.

THE EXPLOSION blew itself out. The hot gases and vapors cooled. The steam condensed. The volcanic dust disappeared. There lay the planet; but changed—hideously and awfully changed. Where Grand Base had been there remained nothing whatever to indicate that anything wrought by man had ever been there. Mountains were leveled, valleys were filled. Continents and oceans had shifted, and were still shifting; visibly. Earthquakes, volcanoes, and other seismic disturbances, instead of decreasing, were increasing in violence, minute by minute.

Helmuth's planet was, and would for years remain, a barren and uninhabitable world.

"Well!" Haynes, who had been holding his breath unconsciously, released it in an almost explosive sigh. "That is inescapably and incontrovertibly *that*. I was going to use that base, but it looks as though we'll have to get along without it."

Without comment Kinnison turned to the gamma-zeta observers. "Any traces?" he asked.

It developed that three of the fields had shown activity. Not merely traces or flashes, but solid punctures showing the presence of a hard, tight beam. And those three punctures were in the same line; a line running straight out into inter-Galactic space.

Kinnison took careful readings on the line, then stood motionless. Feet wide apart, hands jammed into pockets, head slightly bent, eyes distant, he stood there unmoving; thinking with all the power of his brain.

"I want to ask three questions," the old Commandant of Cadets interrupted his cogitations finally. "Was Helmuth Boskone, or not? Have we got them licked, or not? What do we do next, besides the mopping up of those eighteen super-maulers?"

"To all three the answer is 'I don't know'." Kinnison's face was stern and hard. "You know as much about the whole thing as I do—I haven't held back a thing that I even suspect. I did not tell you that Helmuth was Boskone; I said that everyone in any position to judge, including myself, was as sure that he was as one could be about anything that could not be proved. I firmly believed that he was. The presence of this communicator line, and the other stuff I have told you about, has destroyed that belief in my mind. However, we do not actually *know* any more than we did before. It is no more certain now that Helmuth was *not* Boskone than it was before that he *was* Boskone. The second question ties in with the first, and so does the third—but I see that the mopping up has started."

While von Hohendorff and Kinnison had been talking, Haynes had issued orders and the Grand Fleet, divided roughly and with difficulty into eighteen parts, went raggedly outward to surround the eighteen outlying fortresses. But, and surprisingly enough to the Patrol forces, the reduction of those hulking monsters was to prove no easy task.

The Boskonians had witnessed the destruction of Helmuth's Grand Base. Their master plates were dead. Try as they would, they could get in touch with no one with authority to give them orders, with no one to whom they could report their present plight. Nor could they escape: the slowest mauler in the Patrol Fleet could have caught any one of them in space of minutes.

To surrender was not even thought of —better far to die a clean death in the blazing holocaust of space battle than to be thrown ignominiously into the lethal chambers of the Patrol. There was not, there could not be, any question of pardon or of sentence to any mere imprisonment, for the strife between Civilization and Boskonia in no respect resembled the wars between two fundamentally similar and friendly nations which small, green Terra knew so frequently of old. It was a Galaxy-wide struggle for survival between two diametrically opposed, mutually exclusive, and absolutely incompatible cultures; a duel to the death in which quarter was neither asked nor given; a conflict which, except for the single instance which Kinnison himself had engineered, was, and of stern necessity had to be, one of ruthless, complete, and utter extinction.

DIE, THEN, the pirates knew they must; and, although adherents to a scheme of existence monstrous indeed to our way of thinking, they were in no sense cowards. Not like cornered rats did they conduct themselves, but fought like what they were; courageous beings hopelessly outnumbered and outpowered, unable either to escape or to choose the field of operations, grimly resolved that in their passing they would take full toll of the minions of that detested and

despised Galactic Civilization. Therefore, in suicidal glee, Boskonian engineers rigged up a fantastically potent weapon of offense, tuned in their defensive screens and hung poised in space, awaiting calmly the massed attack so sure to come.

Up flashed the heavy cruisers of the Patrol, serenely confident. Although of little offensive strength, these vessels mounted tractors and pressors of prodigious power, as well as defensive screens which—theoretically—no projector-driven beam of force could puncture. They had engaged mauler after mauler of Boskonia's mightiest, and never yet had one of those screens gone down. Theirs the task of immobilizing the opponent; since, as is of course well known, it is under any ordinary conditions impossible to wreak any hurt upon an object which is both inertialess and at liberty to move in space. It simply darts away from the touch of the harmful agent, whether it be immaterial beam or material substance.

Formerly the attachment of two or three tractors was all that was necessary to insure immobility, and thus vulnerability; but with the Velantian development of a shear-plane to cut tractor beams, a new technique became necessary. This was englobement, in which a dozen or more vessels surrounded the proposed victim in space and held it motionless at the center of a sphere by means of pressors, which could not be cut or evaded. Serene, then, and confident, the heavy cruisers rushed out to englobe the Boskonian fortress.

Flash! Flash! Flash! Three points of light, as unbearably brilliant as atonic vortices, sprang into being upon the fortress' side. Three needle rays of inconceivable energy lashed out, hurtling through the cruisers' outer screens as though they had been so much inactive webbing. Through the second and through the first. Through the wall shield, even that ultrapowerful field scarcely flashing as it went down. Through the armor, violating the prime tenet then held and which has just been referred to, that no object free in space can be damaged—in this case, so unthinkably vehement was the thrust, the few atoms of substances in the space surrounding the doomed cruisers afforded resistance enough. Through the ship itself, a ravening cylinder of annihilation.

For perhaps a second—certainly no longer—those incredible, those undreamed-of beams persisted before winking out into blackness; but that second had been long enough. Three riddled hulks lay dead in space, and as the three original projectors went black three more flared out. Then three more. Nine of the mightiest of Civilization's ships of war were riddled before the others could hurl themselves backward out of range!

MOST OF THE officers of the flagship were stunned into temporary inactivity by that shocking development, but two reacted almost instantly.

"Thorndyke!" the Admiral snapped. "What did they do, and how?"

And Kinnison, not speaking at all, leaped to a certain panel, to read for himself the analysis of those incredible beams of force.

"They made superneedle rays out of their main projectors," Master Technician Laverne Thorndyke reported, crisply. "They must have shorted everything they've got onto them to burn them out that fast."

"Those beams were hot—plenty hot," Kinnison corroborated the findings. "These recorders go to five billion and have a factor of safety of ten. Even that wasn't anywhere nearly enough—everything in the recorder circuits blew."

"But how could they handle them—" von Hohendorff began to ask.

"They didn't. They pointed them

and died," Thorndyke explained, grimly. "They traded one projector and its crew for one cruiser and *its* crew—a good trade from their viewpoint."

"There will be no more such trades," Haynes declared.

Nor were there. The Patrol had maulers enough to englobe the enemy craft at a distance greater even than the effective range of those suicidal beams, and it did so.

Shielding screens cut off the Boskonians' intake of cosmic power and the relentless beaming of the bulldog maulers began. For hour after hour it continued. the cordon ever tightening as the victims' power lessened. And finally even the Gargantuan accumulators of the immense fortresses were drained. Their screens went down under the hellish fury of the maulers' incessant attack, and in a space of minutes thereafter the structures and their contents ceased to exist save as atomic detritus.

The Grand Fleet of the Galactic Patrol remade its formation after a fashion and set off toward the Galaxy at touring blast.

And in the control room of the flagship three Lensmen brought a very serious conference to a close.

"You saw what happened to Helmuth's planet," Kinnison's voice was oddly hard, "and I gave you all I could get of the thought about the destruction of all life upon Sol III. A big-enough duodec bomb in the bottom of an ocean would do it. I don't really *know* anything except that we hadn't better let them catch us asleep at the switch again —we've got to be up on our toes every second."

And the Gray Lensman, face set and stern, strode off to his quarters.

II.

DURING practically all of the long trip back to Earth, Kinnison kept pretty much to his cabin, thinking deeply, blackly, and, he admitted ruefully to himself, to very little purpose. And at Prime Base, through week after week of its feverish activity, he continued to think. Finally, however, he was snatched out of his dark abstraction by no less a personage than Surgeon General Lacy.

"Snap out of it, lad," that worthy advised, smilingly. "When you concentrate on one thing too long, you know, the vortices of thought occupy narrower and narrow loci, until finally the effective volume becomes infinitesimal. Or, mathematically, the then range of cogitation, integrated between the limits of plus and minus infinity, approaches zero as a limit—"

"Huh? What are you talking about?" the Lensman demanded.

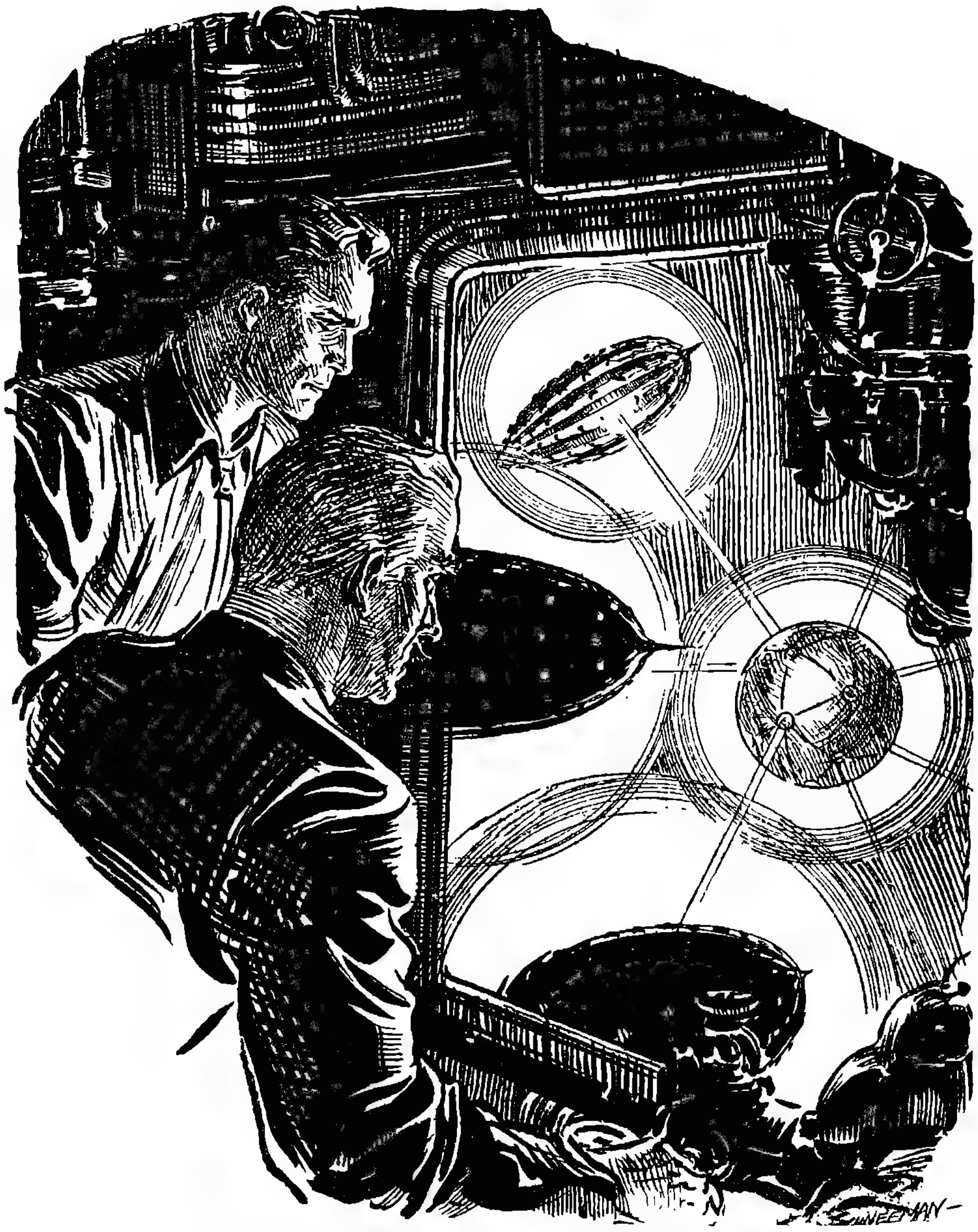
"Poor mathematics, perhaps, but sound psychology," Lacy grinned. "It got your undivided attention, didn't it? That was what I was after. In plain English, if you keep on thinking around in circles you'll soon be biting yourself in the small of the back. Come on, you and I are going places."

"Where?"

"To the Grand Ball in honor of the Grand Fleet, my boy—old Dr. Lacy prescribes it for you as a complete and radical change of atmosphere. Let's go!"

The city's largest ballroom was a blaze of light and color. A thousand polychromic lamps flooded their radiance downward through draped bunting upon an even more colorful throng. Two thousand items of feminine loveliness were there, in raiment whose fabrics were the boast of hundreds of planets, whose hues and shades put the spectrum itself to shame. There were over two thousand men, clad in plain or beribboned or bemedaled full civilian dress, or in the variously panoplied dress uniforms of the many Services.

"You're dancing with Miss Forrester first, Kinnison," the surgeon introduced them informally, and the



"But that's not the end, sir," said Kinnison. "They said not 'the' galaxy, or even 'this' galaxy—the thought was 'that' galaxy!"

Lensman found himself gliding away with a stunning blonde, ravishingly and revealingly dressed in a dazzlingly blue wisp of Manarkan glamorette—fashion's *dernier cri.*

To the uninformed, Kinnison's garb of plain gray leather might have seemed incongruous indeed in that brilliantly and fastidiously dressed assemblage. But to those people, as to us of today, the

drab, starkly utilitarian uniform of the Unattached Lensman transcended far any other, however resplendent, worn by men: and literally hundreds of eyes followed the strikingly handsome couple as they slid rhythmically out upon the polished floor. But a measure of the tall beauty's customary poise had deserted her. She was slimly taut in the circle of the Lensman's arm, her eyes were downcast, and suddenly she missed a step.

"'Scuse me for stepping on your feet," he apologized. "A fellow gets out of practice, flitting around in a speedster so much."

"Thanks for taking the blame, but it's my fault entirely—I know it as well as you do," she replied, flushing uncomfortably. "I *do* know how to dance, to, but— Well, you're a Gray Lensman, you know."

"Huh?" he ejaculated, in honest surprise, and she looked up at him for the first time. "What has that fact got to do with the price of Venerian orchids in Chicago—or with my clumsy walking all over your slippers?"

"EVERYTHING in the world," she assured him. Nevertheless, her stiff young body relaxed and she fell into the graceful, accurate dancing which she really knew so well how to do. "You see, I don't suppose that any of us has ever seen a Gray Lensman before, except in pictures, and actually to be dancing with one is so thrilling that it is really a shock—I have to get used to it gradually, so to speak. Why, I don't even know how to talk to you! One couldn't possibly call you plain mister, as one would any ord—"

"It'll be QX if you just call me 'say'!" he informed her. "Maybe you'd rather not dance with a dub? What say we go get us a sandwich and a bottle of fayalin or something?"

"No—never!" she exclaimed. "I didn't mean it that way at all. I'm going to have this full dance with you, and enjoy every second of it. And later I am going to pack this dance card—which I hope you will sign for me—away in lavender, so it will go down in history that in my youth I really did dance with Gray Lensman Kinnison. I see that I have recovered enough so that I can talk and dance at the same time. Do you mind if I ask you some silly questions about space?"

"Go ahead. They won't be silly, if I'm any judge. Elementary, perhaps, but not silly."

"I hope so, but I think you're being charitable again. Like most of the girls here, I suppose, I have never been out in deep space at all. Besides a few hops to the Moon, I have taken only two flits, and they were both only interplanetary. One to Mars and one to Venus. I never could see how you deep-space men can really understand what you're doing—either the frightful speeds at which you travel, the distance you cover, or the way your communicators work. In fact, a professor told us that no human mind can understand figures of those magnitudes at all. But you must understand them, I should think oh, perhaps—"

"Or maybe the guy isn't human?" Kinnison laughed deeply, infectiously. "No, your professor was right. We can't understand the figures, but we don't have to—all we have to do is to work with them. And, now that it has just percolated through my skull who you really are, that you are *Gladys* Forrester, it is quite clear that you are in that same boat."

"Me? How?" she exclaimed.

"The human mind cannot really understand a million of anything. Yet your father, an immensely wealthy man, gave you clear title to a million credits in cash, to train you in finance in the only way that really produces results—the hard way of actual experience. You lost a lot of it at first, of course; but at

last accounts you had got it all back, and some besides, in spite of all the smart guys trying to take it away from you. The fact that your brain cannot envisage a million credits has not interfered with your manipulation of that amount, has it?"

"No, but that's entirely different!" she protested.

"Not in any essential feature," he countered. "I can explain it best, perhaps, by analogy. You can't visualize, mentally, the size of North America, either, yet that fact does not bother you in the least while you are driving around on it in an automobile. What do you drive? On the ground, I mean, not in the air?"

"A De Khotinsky sporter."

"Um. Top speed a hundred and forty miles per hour, and I suppose you cruise between ninety and a hundred. We'll have to pretend that you drive a Crownover sedan, or some other big, slow jellopy, so that you will tour at about sixty and have an absolute top of ninety. Also, you have a radio. On the broadcast bands you can hear a program from three or four thousand miles away; or, on short wave, from anywhere on Tellus—"

"I can get tight-beam short-wave programs from the Moon," the girl broke in. "I've heard them lots of times."

"Yes," Kinnison assented dryly, "at such times as there didn't happen to be any interference."

"Static *is* pretty bad, lots of times," the heiress agreed.

"WELL, change 'miles' to 'parsecs' and you've got the picture of deep-space speeds and operations," Kinnison informed her. "Our speed varies, of course, with the density of matter in space; but on the average—say one atom of substance per ten cubic centimeters in space—we tour at about sixty parsecs an hour, and full blast is about ninety. And our ultra-wave communicators, working below the level of the ether, in the sub-ether—"

"Whatever that is," she interrupted.

"That's as good a description or definition of it as any," he grinned at her. "We don't know what even the ether is, or whether or not it exists as an objective reality; to say nothing of what we so nonchalantly call the sub-ether. We do not understand gravity, although we can make it to order. No scientist yet has been able to say how it is propagated, or even whether or not it *is* propagated. No one has been able to devise any kind of an apparatus or meter or method by which its nature, period, or velocity can be determined. Neither do we know anything about time or space. In fact, fundamentally, we don't really *know* much of anything at all," he concluded.

"Says you. But that makes me feel better, anyway," she confided, snuggling a little closer. "Go on about the communicators."

"Ultra-waves are faster than ordinary radio waves, which of course travel through the ether with the velocity of light, in just about the same ratio as that of the speed of our ships to the speed of slow automobiles—that is, the ratio of a parsec to a mile. Roughly nineteen billion to one. Range, of course, is proportional to the square of the speed."

"Nineteen billion!" she exclaimed. "And you just said that nobody could understand even a million!"

"That's the point exactly," he went on, undisturbed. "You don't have to understand or to visualize it. All you have to do is to remember that deep-space vessels and communicators can cover distance in parsecs at practically the same rate that Tellurian automobiles can cover miles. So, when some space-flea talks to you about parsecs, just think of miles in terms of an automobile and a radio and you won't be far off."

"I never heard it explained that way before—it does make it ever so much

simpler. Will you sign this, please?"

"Just one more point." The music had ceased and he was signing her card, preparatory to escorting her back to her place. "Like your supposedly tight-beam Luna-Tellus hookups, our long range, equally tight-beam communicators are very sensitive to interference, either natural or artificial. So, while under perfect conditions we can communicate clear across the Galaxy, there are times—particularly when the pirates are scrambling the channels—that we can't drive a beam from here to Alpha Centauri. Thanks a lot for the dance."

THE OTHER girls did not quite come to blows as to which of them was to get him next; and shortly—he never did know exactly how it came about—he found himself dancing with a luscious, cuddly little brunette, clad—partially clad, at least—in a high-slitted, flame-colored sheath of some new fabric which the Lensman had never seen before. It looked like solidified, tightly woven electricity!

"Oh, Mr. Kinnison!" his new partner cooed, ecstatically. "I think that all spacemen, and you Lensmen particularly, are just too perfectly darn *her*oic for anything! Why, I think that space is just *terrible!* I simply can't *cope* with it at *all!*"

"Ever been out, miss?" he grinned. He had never known many social butterflies, and temporarily he had forgotten that such girls as this one really existed.

"Why, of *course!*" The young woman kept on being exclamatory.

"Clear out to the Moon, perhaps?" he hazarded.

"Don't be ridic! *Ever* so much farther than *that!* Why, I went clear to *Mars!* And it gave me the screaming *meanies,* no less. I thought I would *collapse!*"

That dance ended ultimately, and other dances with other girls followed; but Kinnison could not throw himself into the gaiety surrounding him. During his cadet days he had enjoyed such revels to the full, but now the whole thing left him cold. His mind insisted upon reverting to its problem. Finally, in the throng of young people on the floor, he saw a girl with a mass of red-bronze hair and a supple, superbly molded figure. He did not need to await her turning to recognize his erstwhile nurse and later assistant, whom he had last seen just this side of far-distant Boyssia II.

"Mac!" To her mind alone he sent out a thought through his Lens. "For the love of Klono, lend a hand—rescue me! How many dances have you got ahead?"

"None at all—I'm not dating ahead." She jumped as though someone had jabbed her with a needle, then paused in panic; eyes wide, breath coming fast, breast pounding. She had felt Lensed thoughts before, but this was something else, something entirely different. Every cell of her brain was open to that Lensman's mind—and what *was* she seeing! She blanketed her thoughts desperately, tried with all her might not to think at all!

"QX, Mac," the thought went quietly on within her mind, quite as though nothing unusual were occurring. "No intrusion meant. You didn't think it; I already knew that if you started dating ahead you'd be tied up until day after tomorrow. Can I have the next one?"

"Sure, Kim."

"Thanks—the Lens is off for the rest of the evening."

She sighed in relief as he snapped the telepathic line as though he were hanging up the receiver of a telephone.

"I'd like to dance with you all, kids," he addressed a large group of buds surrounding him and eying him hungrily, "but I've got this next one. See you later, perhaps," and he was gone.

"Sorry, fellows," he remarked casually, as he made his way through the circle of men around the gorgeous redhead. "Sorry, but this dance is mine, isn't it, Miss MacDougall?"

She nodded, flashing the radiant smile which had so aroused his ire during his hospitalization. "I heard you invoke your spaceman's god, but I was beginning to be afraid that you had forgotten this dance."

"And she said she wasn't dating ahead—the diplomat!" murmured an ambassador, aside.

"Don't be a dope," a captain of Marines muttered in reply. "She meant with *us*. That's a Gray Lensman!"

ALTHOUGH the nurse, as has been said, was anything but small, she appeared almost petite against the Lensman's mighty frame as they took off. Silently the two circled the great hall once; lustrous, goldenly green gown—of Earthly nylon, this one, and less revealing than most—swishing in perfect cadence against deftly and softly stepping high-laced boots.

"This is better, Mac," Kinnison sighed, finally, "but I lack just seven thousand kilocycles of being in tune with this. Don't know what's the matter, but it's clogging my jets. I must be getting to be a space-louse."

"A space-louse—you? Uh-uh!" She shook her head. "You know very well what the matter is. You're just too much of a man to mention it."

"Huh?" he demanded.

"Uh-huh," she asserted, positively if obliquely. "Of course you're not in tune with this crowd. How could you be? I don't fit into it any more myself, and what I'm doing isn't even a muffled flare compared to your job. Not one in ten of these fluffs here tonight has ever been beyond the stratosphere; not one in a hundred has ever been out as far as Jupiter, or has ever had a serious thought in her head except about clothes or men; not one of them all has any more idea of what a Lensman really is than I have of hyperspace or of non-Euclidean geometry!"

"Kitty, kitty!" he laughed. "Sheathe the little claws, before you scratch somebody!"

"That isn't cattishness; it's the bare-faced truth. Or perhaps," she amended, honestly, "it's both true and cattish, but it's certainly true. And that isn't half of it. No one in the Universe except yourself really *knows* what you are doing, and I'm pretty sure that only two others even suspect. And Dr. Lacy is not one of them," she concluded, surprisingly.

Though shocked, Kinnison did not miss a step. "You *don't* fit into this matrix, any more than I do," he agreed, quietly. "S'pose you and I could do a little flit somewhere?"

"Surely, Kim," and, breaking out of the crowd, they strolled out into the grounds. Not a word was said until they were seated upon a broad, low bench beneath the spreading foliage of a tree,

Then: "What did you come here for tonight, Mac—the real reason?" he demanded, abruptly.

"I . . . me . . . you . . . I mean— Oh, skip it!" the girl stammered, a wave of scarlet flooding her face and down even to her superb, bare shoulders. Then she steadied herself and went on: "You see, I agree with you—as you say, I check you to nineteen decimals. Even Dr. Lacy, with all his knowledge, can be slightly screwy at times, I think."

"Oh, so that's it!" It was not, it was only a very minor part of her reason; but the nurse would have bitten her tongue off rather than admit that she had come to that dance solely and only because Kimball Kinnison was to be there. "You knew, then, that this was old Lacy's idea?"

"Of course. You would never have

come, else. He thinks that you may begin wobbling on the beam pretty soon unless you put out a few braking jets."

"And you?"

"Not in a million, Kim. Lacy is as cockeyed as Trenco's ether, and I as good as told him so. He may wobble a bit, but *you* won't. You've got a job to do, and you're doing it. You'll finish it, too, in spite of all the vermin infesting all the galaxies of the macro-cosmic Universe!" she finished, passionately.

"Klono's brazen whiskers, Mac!" He turned suddenly and stared intently down into her wide, gold-flecked, tawny eyes. She stared back for a moment, then looked away.

"Don't look at me like that!" she almost screamed. "I can't stand it—you make me feel stark naked! I know that your Lens is off—I'd simply die if it wasn't—but I think that you're a mind-reader, even without it!"

SHE DID know that that powerful telepath was off and would remain off, and she was glad indeed of that fact; for her mind was seething with thoughts which that Lensman must not know, then or ever. And for his part, the Lensman knew what she did not even suspect; that had he chosen to exert the powers at his command she would have been naked, mentally and physically, to his perception; but he did not exert those powers—then. The amenities of human relationship demanded that some fastnesses of reserve remain inviolate, but he had to know what this woman knew. If necessary, he would take the knowledge away from her by force, so completely that she would never know that she had ever known it. Therefore:

"Just what do you know, Mac, and how did you find it out?" he demanded; quietly, but with a stern finality of inflection that made a quick chill run up and down the nurse's back.

"I know a lot, Kim." The girl shivered slightly, even though the evening was warm and balmy. "I learned it from your own mind. When you called me, back there on the floor, you didn't send just a single, sharp thought, just as though you were speaking to me, as you always did before. Instead, it seemed as though I was actually inside your own mind—the whole of it. I have heard Lensman speak of a wide-open two-way, but I never had even the faintest inkling of what it would be like—no one could who has never experienced it. Of course I didn't—I couldn't—understand a millionth of what I saw, or seemed to see. It was too vast, too incredibly immense. I never dreamed any mortal *could* have a mind like that, Kim! But it was ghastly, too. It gave me the creepy jitters. It sent me down completely out of control for a second. And you didn't even know it—I know you didn't! I didn't want to look, really, but I couldn't help seeing, and I'm glad I did—I wouldn't have missed it for the world!" she finished, almost incoherently.

"Hm-m-m. That changes the picture entirely." Much to her surprise, the man's voice was calm and thoughtful; not at all incensed. Not even disturbed. "So I spilled the beans myself, on a wide-open two-way, and didn't even realize it. I knew that you were backfiring about something, but thought it was because I might think you guilty of petty vanity. And I called *you* a dumbbell once!" he marveled.

"Twice," she corrected him, "and the second time I was never so glad to be called names in my whole life."

"Now I *know* that I was getting to be a space-louse."

"Uh-uh, Kim," she denied again, gently. "And you aren't a brat or a lug or a clunker, either, even though I have thought at times that you were all of those things. But, now that I've actually got all this stuff, what can you—what can we—do about it?"

"Perhaps . . . probably . . . I think, since I gave it to you myself, I'll let you keep it," Kinnison decided, slowly.

"Keep it!" she exclaimed. "Of course, I'll keep it! Why, it's in my mind—I'll *have* to keep it—nobody can take *knowledge* away from anyone!"

"Oh, sure—of course," he murmured, absently. There were a lot of things that Mac didn't know, and probably no good end would be served my enlightening her further. "You see, there's a lot of stuff in my mind that I don't know much about myself, yet. Since I gave you an open channel, there must have been a good reason for it, even though, consciously, I don't know myself what it was." He thought intensely for moments, then went on: "Undoubtedly the subconscious. Probably it recognized the necessity of discussing the whole situation with someone having a fresh viewpoint, someone whose ideas can help me develop a fresh angle of attack. Haynes and I think too much alike for him to be of much help."

"You trust *me* that much?" the girl asked, dumfounded.

"Certainly," he replied without hesitation. "I know enough about you to know that you can keep your mouth shut."

THUS unromantically did Kimball Kinnison, Gray Lensman, acknowledge the first glimmerings of the dawning perception of a vast fact—that this nurse and he were two between whom there never would nor could exist any iota of doubt or of question.

Then they sat and talked. Not idly, as is the fashion of lovers, of the minutiae of their own romantic affairs, did these two converse, but cosmically, of the entire Universe and of the already existent conflict between the culture of Civilization and Boskonia.

They sat there, romantically enough to all outward seeming; their privacy assured by Kinnison's Lens and by his ever-watchful sense of perception. Time after time, completely unconsciously, that sense reached out to other couples who approached, to touch and to affect their minds so insidiously that they did not know that they were being steered away from the tree in whose black moon-shadow sat the Lensman and the nurse.

Finally the long conversation came to an end and Kinnison assisted his companion to her feet. His frame was straighter, his eyes held a new and brighter light.

"By the way, Kim," she asked idly as they strolled back toward the ballroom, "who is this Klono, by whom you were swearing a while ago? Another spaceman's god, like Noshabkeming, of the Valerians?"

"Something like him, only more so," he laughed. "A combination of Noshabkeming, some of the gods of the ancient Greeks and Romans, all three of the Fates, and quite a few other things as well. I think, originally, from Corvina, but fairly widespread through certain sections of the Galaxy now. He's got so much stuff—teeth and horns, claws and whiskers, tail and everything—that he's much more satisfactory to swear by than any other space-god I know of."

"But why do men have to swear at all, Kim?" she queried, curiously. "It's so silly."

"For the same reason that women cry," he countered. "A man swears to keep from crying, a woman cries to keep from swearing. Both are sound psychology. Safety valves—means of blowing off excess pressure that would otherwise blow fuses or burn out tubes."

III.

IN THE library of the Port Admiral's richly comfortable home, a room as heavily guarded against all forms of

intrusion as was his private office, two old but active Lensmen sat and grinned at each other like the two conspirators which in fact they were. One took a squat, red bottle of fayalin from a cabinet and filled two small glasses. The glasses clinked, rim to rim.

"Here's to love!" Haynes gave the toast.

"Ain't it grand!" Surgeon General Lacy responded.

"Down the hatch!" they chanted in unison, and action followed word.

"You aren't asking if everything stayed on the beam." This from Lacy.

"No need. I had a spy ray on the whole performance."

"You would—you're the type. However, I would have, too, if I had a panel full of them in *my* office. Well, say it, you old space-hellion!" Lacy grinned again, albeit a trifle wryly.

"Nothing to say, sawbones. You did a grand job, and you've got nothing to blow a jet about."

"No? How would you like to have a red-headed spitfire who's scarcely dry behind the ears yet tell you to your teeth that you've got softening of the brain? That you had the mental capacity of a gnat, the intellect of a Zabriskan fontema? And to have to take it, without even heaving the insubordinate young jade into the can for about twenty-five well-earned black spots?"

"Oh, come, now, you're just blasting. It wasn't that bad."

"Perhaps not quite—but it was bad enough."

"She'll grow up, some day, and realize that you were foxing her six ways from the origin."

"Probably. In the meantime, it's all part of the bigger job. Thank God I'm not young any more. They suffer so."

"Check. *How* they suffer!"

"But you saw the ending and I didn't. How did it turn out?" Lacy asked.

"Partly good, partly bad." Haynes slowly poured two more drinks and thoughtfully swirled the crimson, pungently aromatic liquid around and around in his glass before he spoke again. "Hooked—but she knows it, and I'm afraid she'll do something about it."

"She's a smart girl—I told you she was. She doesn't fox herself about anything. Hm-m-m. And separation is indicated, it would seem."

"Check. Can you send out a hospital ship somewhere, so as to get rid of her for two or three weeks?"

"Can do. Three weeks be enough? We can't send him anywhere, you know."

"Plenty. He'll be gone in two." Then, as Lacy glanced at him questioningly, Haynes continued: "Ready for a shock? He's going to Lundmark's Nebula.

"But he *can't!* That would take years! Nobody has ever got back from there yet, and there's this new job of his. Besides, this separation is only supposed to last until you can spare him for a while!"

"If it takes very long he's coming back. The idea has always been, you know, that inter-galactic matter may be so thin—one atom per liter or so—that such a flit won't take one tenth the time supposed. We recognize the danger. He's going well heeled."

"How well?"

"The best that we can give him."

"I hate to clog their jets this way, but it's got to be done. We'll give her a raise when I send her out—make her sector chief. Huh?"

"Did I hear any such words lately as 'spitfire,' 'hussy,' and 'jade,' or did I dream them?" Haynes asked, quizzically.

"She's all of them, and more—but she's one of the best nurses and one of the finest women this side of Hades, too!"

"QX, Lacy, give her her raise. Of course she's good, or she wouldn't be in on this deal at all. In fact, they're about as fine a couple of youngsters as old Tellus has produced."

"They are that. Man, *what* a pair of skeletons!"

AND IN the Nurses' Quarters a young woman with a wealth of red-bronze-auburn hair and tawny eyes was staring at her own reflection in a mirror.

"You half-wit, you ninny, you lug!" she stormed, bitterly if almost inaudibly, at that reflection. "You lame-brained moron, you red-headed, idiotic imbecile, you microcephalic dumbbell, you *clunker!* Of all the men in this whole cockeyed galaxy, you *would* have to make a dive at Kimball Kinnison, the one man who never has realized that you are even alive. At a Gray Lensman—" Her expression changed and she whispered softly: "A . . . Gray Lensman. He *can't* love any woman as long as he's carrying that load. They can't let themselves be human—quite; perhaps loving him will be enough—"

She straightened up, shrugged, and smiled; but even that pitiful travesty of a smile could not long endure. Shortly it was buried in waves of pain and the girl threw herself down upon her bed.

"Oh Kim, Kim!" she sobbed. "I wish . . . why can't you— Oh, why did I ever have to be born!"

THREE WEEKS LATER, far out in space, Kimball Kinnison was thinking thoughts entirely foreign to his usual pattern. He was in his bunk, smoking dreamily, staring unseeing at the metallic ceiling. He was not thinking of Boskone.

When he had thought of Mac, back there at that dance, he had, for the first time in his life, failed to narrow down his beam to the exact thought being sent. Why? The explanation he had given the girl was totally inadequate. For that matter, why had he been so glad to see her there? And why, at every odd moment, did visions of her keep coming into his mind—her form and features, her eyes, her lips, her startling hair?

She was beautiful, of course, but not nearly such a seven-sector callout as that thionite dream he had met on Aldebaran II—and his only thought of *her* was an occasional faint regret that he had not half wrung her lovely neck. Why, she wasn't really as good-looking as, and didn't have half the *je ne sais quoi* of, that blond heiress—what was her name?—oh, yes, Forrester—

There was only one answer, and it jarred him to the core—he would not admit it, even to himself. He couldn't love anybody—it just simply was not in the cards. He had a job to do. The Patrol had spent a million credits making a Lensman out of him, and it was up to him to give them some kind of a run for their money. No Lensman had any business with a wife, especially a Gray Lensman. He couldn't sit down anywhere, and she couldn't flit with him. Besides, nine out of every ten Gray Lensmen got killed before they finished their jobs, and the one that did happen to live long enough to retire to a desk was almost always half machinery and artificial parts—

No, not in seven thousand years. No woman deserved to have her life made into such a hell on earth as that would be—years of agony, of heart-breaking suspense, climaxed by untimely widowhood; or, at best, the wasting of the richest part of her life upon a husband who was half steel, rubber, and phenoline plastic. Red in particular was much too splendid a person to be let in for anything like that—

But hold on—jet back! What made him think that he rated any such girl? That there was even a possibility—especially in view of the way he had behaved while under her care in Base Hospital—that she would ever feel like being anything more to him than a strictly

impersonal nurse? Probably not. He had Klono's own brazen gall to think that she would marry him, under any conditions, even if he made a full-power dive at her.

Just the same, she might. Look at what women did fall in love with, sometimes. So he would never make any kind of a dive at her; no, not even a pass. She was too sweet, too fine, too vital a woman to be tied to any space-louse; she deserved happiness, not heartbreak. She deserved the best there was in life, not the worst; the whole love of a whole man for a whole lifetime, not the fractions which were all that he could offer any woman. As long as he could think a straight thought he wouldn't make any motions toward spoiling her life. In fact, he hadn't better see Reddy again. He wouldn't go near any planet she was on, and if he saw her out in space he'd go somewhere else at ten gravities.

With a bitter imprecation Kinnison sprang out of his bunk, hurled his half-smoked cigarette at an ash tray, and strode toward the control room.

THE SHIP he rode was of the Patrol's best. Superbly powered for flight, defense, and offense, she was withal a complete space-laboratory and observatory; and her personnel, over and above her regular crew, was as varied as her equipment. She carried ten Lensmen—a circumstance unique in the annals of space, even for such a trouble-shooting battle wagon as the *Dauntless* was; a scientific staff which was practically a cross section of the Tree of Knowledge. She carried Lieutenant Peter van Buskirk and his company of Valerian wild cats; Worsel of Velantia and threescore of his reptilian kinsmen; Tregonsee, the blocky Rigellian Lensman, and a dozen or so of his fellows; Master Technician LaVerne Thorndyke and his crew. She carried three Master Pilots, Prime Base's best —Henderson, Schermerhorn, and Watson.

The *Dauntless* was an immense vessel. She had to be, in order to carry, in addition to the men and the things requisitioned by Kinnison, the personnel and the equipment which Port Admiral Haynes had insisted upon sending with him.

"But great Klono, chief, think of what a hole you're making in Prime Base if we don't get back!" Kinnison had protested.

"You're coming back, Kinnison," the Port Admiral had replied gravely. "That is why I am sending these men and this stuff along—to be as sure as I possibly can that you *do* get back."

Now they were out in inter-galactic space, and the Gray Lensman, lying flat upon his back with his eyes closed, sent his sense of perception out beyond the confining iron walls and let it roam the void. This was better than a visiplate; with no material barriers or limitations he was feasting upon a spectacle scarcely to be pictured in the most untrammeled imaginings of man. There were no planets, no suns, no stars; no meteorites, no particles of cosmic debris. All nearby space was empty, with an indescribable perfection of emptiness at the very thought of which the mind quailed in uncomprehending horror. And, accentuating that emptiness, at such mind-searing distances as to be dwarfed into buttons, and yet, because of their intrinsic massiveness, starkly apparent in their three-dimensional relationships, there hung poised and motionlessly stately the component galaxies of a universe.

Behind the flying vessel the First Galaxy was a tiny, brightly shining lens, so far away that such minutiae as individual solar systems were invisible, so distant that even the gigantic masses of its accompanying globular star clusters were merged indistinguishably into its sharply lenticular shape. In

front of her, to right and to left of her, above and beneath her were other galaxies, never explored by man or by any other beings subscribing to the code of Galactic Civilization. Some, edge on, were thin, waferlike. Others appeared as full disks, showing faintly or boldly the prodigious, mathematically inexplicable spiral arms by virtue of whose obscure functioning they had come into being. Between these two extremes there was every possible variant in angular displacement.

Utterly incomprehensible although the speed of the space-flyer was, yet those galaxies remained relatively motionless, hour after hour. What distances! What magnificence! What grandeur! What awful, what poignantly solemn calm!

Despite the fact that Kinnison had gone out there expecting to behold that very scene, he felt awed to insignificance by the overwhelming, the cosmic immensity of the spectacle. What business had he, a sub-electronic midge from an ultra-microscopic planet, venturing out into macro-cosmic space, a demesne comprehensible only to the omniscient and omnipotent Creator?

HE GOT UP, shaking off the futile mood. This wouldn't get him to the first check station, and he had a job to do. And, after all, wasn't man as big as space? Could he have come out here, otherwise? He was. Yes, man was bigger even than space. Man, by his very envisionment of macro-cosmic space, had already mastered it.

Besides, the Boskonians, whoever they might be, had certainly mastered it; he was now certain that they were operating upon an inter-galactic scale. Even after leaving Tellus he had hoped and had really expected that his line would lead to a stronghold in some star cluster belonging to his own Galaxy, so distant from it, or perhaps so small, as to have escaped the notice of the chartmakers; but such was not the case. No possible error in either the determination or the following of that line placed it anywhere near any such cluster. It led straight to and only to Lundmark's Nebula; and that Galaxy was, therefore, his present destination.

Man was certainly as good as the pirates; probably better, on the basis of past performance. Of all the races of the Galaxy, man had always taken the initiative, had always been the leader and commander. And, with the exception of the Arisians, man had the best brain in the Galaxy.

The thought of that eminently philosophical race gave Kinnison pause. His Arisian sponsor had told him that by virtue of the Lens the Patrol should be able to make Civilization secure throughout the Galaxy. Just what did that mean—that it could not go outside? Or did even the Arisians suspect that Boskonia was in fact inter-galactic? Probably. The mentor had said that, given any one definite fact, a really competent mind could envisage the entire Universe; even though he had added carefully that his own mind was not a really competent one.

But this, too, was idle speculation, and it was time to receive and to correlate some more reports. Therefore, one by one, he got in touch with scientists and observers.

The density of matter in space, which had been lessening steadily, was now approximately constant at one atom per four hundred cubic centimeters. Their speed was therefore about a hundred thousand parsecs per hour; and, even allowing for the slowing up at both ends due to the density of the medium, the trip should not take over ten days.

The power situation, which had been his gravest care, since it was almost the only factor not amenable to theoretical solution, was even better than anyone had dared hope; the cosmic energy available in space had actually been

She froze suddenly, a gasp of horror half suppressed. She was seeing things—sensing things beyond comprehension—

increasing as the matter content decreased—a fact which seemed to bear out the contention than energy was continually being converted into matter in such regions. It was taking much less excitation of the intake screens to produce a given flow of power than any figure ever observed in the denser media within the Galaxy.

Thus, the atomic motors which served as exciters had a maximum power of four hundred pounds an hour; that is,

each exciter could transform that amount of matter into pure energy and employ the output usefully in energizing the intake screen to which it was connected. Each screen, operating normally on a hundred-thousand-to-one ratio, would then furnish its receptor on the ship with energy equivalent to the annihilation of four million pounds per hour of material substance. Out there, however, it was being observed that the intake-exciter ratio, instead of being less than a hundred thousand to one, was actually almost a million to one.

IT WOULD serve no useful purpose here to go further into the details of any more of the reports, or to dwell at any great length upon the remainder of the journey to the Second Galaxy. Suffice it to say that Kinnison and his highly trained crew observed, classified, recorded, and conferred; and that they approached their destination with every possible precaution. Detectors full out, observers were at every plate, the ship it was as immune to detection as Hotchkiss' nullifiers could make it.

Up to the Second Galaxy the *Dauntless* flashed, and into it. Was this island universe essentially like the First Galaxy as to planets and peoples? If so, had they been won over or wiped out by the horrid culture of Boskonia or was the struggle still going on?

"If we assume, as we must, that the line we followed was the trace of Boskone's beam," argued the sagacious Worsel, "the probability is very great that the enemy is in virtual control of this entire Galaxy. Otherwise—if they were in a minority or were struggling seriously for dominion—they could neither have spared the forces which invaded our Galaxy, nor would they have been in condition to rebuild their vessels as they did to match the new armaments developed by the Patrol."

"Very probably true," agreed Kinnison, and that was the consensus of opinion. "Therefore we want to do our scouting very quietly. But in some ways that makes it all the better. If they are in control, they won't be unduly suspicious."

And thus it proved. A planet-bearing sun was soon located, and while the *Dauntless* was still light-years distant from it, several ships were detected. At least, the Boskonians were not using nullifiers!

Spy rays were sent out. Tregonsee, the Rigellian Lensman, exerted to the full his powers of perception, and Kinnison hurled downward to the planet's surface a mental viewpoint and communications center. That the planet was Boskonian was soon learned, but that was all. It was scarcely fortified: no trace could be found of a beam communicating with Boskone.

Solar system after solar system was found and studied, with like result. But finally, out in space, one of the screens showed activity; a beam was in operation between a vessel then upon the plates and some other station. Kinnison tapped it quickly; and, while observers were determining its direction, hardness, and power, a thought flowed smoothly into the Lensman's brain.

"—proceed at once to relieve vessel P4K730. Eichlan, speaking for Boskone, ending message."

"Follow that ship, Hen!" Kinnison directed, crisply. "Not too close, but don't lose him!" He then relayed to the others the orders which had been intercepted.

"The same formula, huh?" Van Buskirk roared, and "Just another lieutenant, that sounds like, not Boskone himself." Thorndyke added.

"Perhaps so, perhaps no." The Gray Lensman was merely thoughtful. "It doesn't prove a thing except that Helmuth was not Boskone, which was already fairly certain. If we can prove that there is such a being as Boskone, and that he is not in this Galaxy—well,

in that case, we'll go somewhere else," he concluded, with grim finality.

THE CHASE was comparatively short, leading toward a yellowish star around which swung eight average-sized planets. Toward one of these flew the unsuspecting pirate, followed by the Patrol vessel, and it soon became apparent that there was a battle going on. One spot upon the planet's surface, either a city or a tremendous military base, was domed over by a screen which was one blinding glare of radiance. And for miles in every direction ships of space were waging spectacularly devastating warfare.

Kinnison shot a thought down into the fortress, and with the least possible introduction or preamble, got into touch with one of its high officers. He was not surprised to learn that those people were more or less human in appearance, since the planet was quite similar to Tellus in age, climate, atmosphere, and mass.

"Yes, we are fighting Boskonia," the answering thought came coldly clear. "We need help, and badly. Can you—"

"We're detected!" Kinnison's attention was seized by a yell from the board. "They're all coming at us at once!"

Whether the scientists of Boskone developed the detector-nullifier before or after Helmuth's failure to deduce the Lensman's use of such an instrument is a nice question, and one upon which a great deal has been said. While interesting, the point is really immaterial here; the facts remaining the same—that the pirates not only had it at the time of the Patrol's first visit to the Second Galaxy, but had used it to such good advantage that the denizens of that recalcitrant planet had been forced, in the sheer desperation of self-preservation, to work out a scrambler for that nullification and to surround their world with its radiations. They could not restore perfect detection, but the conditions for complete nullification were so critical that it was a comparatively simple matter to upset it sufficiently so that an image of a sort was revealed. And, at that close range, any sort of an image was enough.

The *Dauntless*, approaching the planet, entered the zone of scrambling and stood revealed plainly enough upon the plates of enemy vessels. They attacked instantly and viciously; within a second after the lookout had shouted his warning the outer screens of the Patrol ship were blazing incandescent under the furious assaults of a dozen Boskonian beams.

IV.

FOR A MOMENT all eyes were fixed apprehensively upon meters and recorders, but there was no immediate cause for alarm. The builders of the *Dauntless* had builded well; her outer screen, the lightest of her series of four, was carrying the attackers' load with no sign of distress.

"Strap down, everybody," the expedition's commander ordered then. "Inert her, Hen. Match velocity with that base," and as Master Pilot Henry Henderson cut his Bergenholm, the vessel lurched wildly aside as its intrinsic velocity was restored.

Henderson's fingers swept over his board as rapidly and as surely as those of an organist over the banked keys of his console; producing, not chords and arpeggios of harmony, but roaring blasts of precisely controlled power. Each keylike switch controlled one jet. Lightly and fleetingly touched, it produced a gentle urge; at sharp, full contact it yielded a mighty, solid shove; depressed still farther, so as to lock into any one of a dozen notches, it brought into being a torrent of propulsive force of any desired magnitude, which ceased only when its key-release was touched

And Henderson was a virtuoso. Smoothly, effortlessly, but in a space of

seconds the great vessel rolled over, spiraled, and swung until her landing jets were in line and exerting five gravities of thrust. Then, equally smoothly, almost imperceptibly, the line of force was varied until the flame-enshrouded dome was stationary below them. Nobody, not even the two other Master Pilots, and least of all Henderson himself, paid any attention to the polished perfection, the consummate artistry, of the performance. That was his job. He was a Master Pilot, and one of the hallmarks of his rating was the habit of making difficult maneuvers look easy.

"Take 'em now, chief? Can't we, huh?" Chatway, the chief firing officer, did not say those words. He did not need to. The attitude and posture of the C. F. O. and his subordinates made the thought tensely plain.

"Not yet, Chatty," the Lensman answered the unsent thought. "We'll have to wait until they englobe us, so that we can get them all. It's got to be all or none. If even one of them gets away, or even has time to analyze and report on the stuff we're going to use, it'll be just too bad."

He then got in touch with the officer within the beleaguered base and renewed the conversation at the point at which it had been broken off.

"We can help you, I think; but to do so effectively we must have clear ether. Will you please order your ships away, out of even extreme range?"

"For how long? They can do us irreparable damage in one rotation of the planet."

"One-twentieth of that time, at most —if we cannot do it in that time we cannot do it at all. Nor will they direct many beams at you, if any. They will be working on us."

Then, as the defending ships darted away, Kinnison turned to his C. F. O. "QX, Chatty. Open up with your secondaries. Fire at will!"

Then from projectors of a power theretofore carried only by maulers, there raved out against the nearest Boskonian vessels beams of a vehemence compared to which the enemies' own seemed weak, futile. And those were the secondaries!

As has been intimated, the *Dauntless* was an unusual ship. She was enormous. She was bigger even than a mauler in actual bulk and mass; and from needle-beaked prow to jet-studded stern she was literally packed with power—power for any emergency conceivable to the fertile minds of Port Admiral Haynes and his staff of designers and engineers. Instead of two, or at most three intake-screen exciters, she had two hundred. Her bus bars, instead of being the conventional rectangular coppers, of a few square inches cross-sectional area, were laminated members built up of co-axial tubing of pure silver to a diameter of over a yard—multiple and parallel conductors, each of whose current-carrying capacity was to be measured only in millions of amperes. And everything else aboard that mighty engine of destruction was upon the same Gargantuan scale.

TITANIC though those thrusts were, not a pirate ship was seriously hurt. Outer screens went down, and more than a few of the second lines of defense also failed. But that was the Patrolmen's strategy; to let the enemy know that they had weapons of offense somewhat superior to their own, but not quite powerful enough to be a real menace.

In minutes, therefore, the Boskonians rushed up and englobed the newcomer; supposing, of course, that she was a product of the world below, that she was manned by the race who had so long and so successfully fought off Boskonian encroachment.

They attacked, and under the concentrated fury of their beams, the outer screen of the Patrol ship began to fail.

Higher and higher into the spectrum it radiated, blinding white—blue—an intolerable violet glare; then, patchily, through the invisible ultraviolet and into the black of extinction. The second screen resisted longer and more stubbornly, but finally it also went down; the third automatically taking up the burden of defense. Simultaneously, the power of Civilization's projectors weakened, as though the *Dauntless* were shifting her power from offense to defense in order to stiffen her third, and supposedly her last, shielding screen.

"Pretty soon, now, Chatway," Kinnison observed. "Just as soon as they can report that they have us in a bad way; that it is just a matter of time until they blow us out of the ether. Better report now—I'll put you on the spool."

"We are equipped to energize simultaneously eight of the new, replaceable-unit primary projectors," the C. F. O. stated, crisply. "There are twenty-one vessels englobing us, and no others within detection. With a discharge period of point six oh second and a switching interval of point oh nine, the entire action should occupy one point nine eight seconds."

"Chief Communications Officer Nelson on the spool. Can the last surviving ship of the enemy report enough in two seconds to do us material harm?"

"In my opinion it cannot, sir," Nelson reported, formally. "The communications officer is neither an observer nor a technician; he merely transmits whatever material is given him by other officers for transmission. If he is already working a beam to his base at the moment of our first blast, he might be able to report the destruction of vessels, but he could not be specific as to the nature of the agent used. Such a report could do no harm, as the fact of the destruction of the vessels will in any event become apparent shortly. Since we are apparently being overcome easily, however, and this is a routine action, the probability is that this detachment is not in direct communication with Base at any given moment. If not, he could not establish working control in two seconds."

"Kinnison now reporting. Having determined to the best of my ability that engaging the enemy at this time will not enable them to send Boskone any information regarding our primary armament, I now give the word to—*fire.*"

THE UNDERLYING principle of the destructive beam produced by overloading a regulation projector had, it is true, been discovered by a Boskonian technician. In so far as Boskonia was concerned, however, the secret had died with its inventor, since the pirates had at that time no headquarters in the First Galaxy. And the Patrol had had months of time in which to perfect it, for that work was begun before the last of Helmuth's guardian fortress had been destroyed.

The projector was not now fatal to its crew, since they were protected from the lethal back-radiation, not only by shields of force, but also by foot after impenetrable foot of lead, osmium, carbon, and paraffin. The refractories were of neo-cargalloy, backed and permeated by M K R fields; the radiators were constructed of the most ultimately resistant materials known to the science of the age. But even so, the unit had a useful life of but little over half a second, so frightful was the overload at which it was used. Like a rifle cartridge, it was good for only one shot. Then it was thrown away, to be replaced by a new unit.

Those problems were relatively simple of solution. Switching those enormous energies was the great stumbling block. The old Kimmerling block-dispersion circuit breaker was prone to arc over under loads much in excess of a

hundred billion KW, hence could not even be considered in this new application. However, the Patrol force finally succeeded in working out a combination of the immersed-antenna and the semi-permeable-condenser types, which they called the Thorndyke heavy-duty switch. It was cumbersome, of course—any device to interrupt voltages and amperages of the really astronomical magnitude in question could not at that time be small—but it was positive, fast-acting, and reliable.

At Kinnison's word of command, eight of those indescribable primary beams lashed out; stilettos of irresistibly penetrant energy which not even a Q-type helix could withstand. Through screens, through wall shields, and through metal they hurtled in a space of time almost too brief to be measured. Then, before each beam expired, it was swung a little, so that the victim was literally split apart or carved into sections. Performance exceeded by far that of the hastily improvised weapon which had so easily destroyed the heavy cruisers of the Patrol; in fact, it checked almost exactly with the theoretical figures of the designers.

As the first eight beams winked out, eight more came into being, then five more; and meanwhile the mighty secondaries were sweeping the heavens with full-aperture cones of destruction. Metal meant no more to those rays than did organic material; everything solid or liquid whiffed into vapor and disappeared. The *Dauntless* lay alone in the sky of that new world.

"Marvelous—wonderful!" the thought beat into Kinnison's brain as soon as he re-established rapport with the being so far below. "We have recalled our ships. Will you please come down to our space-port at once, so that we can put into execution a plan which has been long in preparation?"

"As soon as your ships are down," the Tellurian acquiesced. "Not sooner, as your landing conventions are doubtless very unlike our own and we do not wish to cause disaster. Give me the word when your field is entirely clear."

THAT WORD came soon, and Kinnison nodded to the pilots. Once more inertialess, the *Dauntless* shot downward, deep into atmosphere, before her inertia was restored. Rematching velocity this time was a simple matter, and upon the towering, powerfully resilient pillars of her landing-jets the inconceivable mass of the Tellurian ship of war settled toward the ground, as lightly seeming as a wafted thistledown.

"Their cradles wouldn't fit us, of course, even if they were big enough—which they aren't, by half," Schermerhorn commented. "Where do they want us to put her?"

"'Anywhere, they say," the Lensman answered. "but we don't want to take that too literally—without a solid dock she'll make an awful hole, wherever we set her down. Won't hurt her any. She's designed for it. We couldn't expect to find cradles to fit her anywhere except on Tellus. I'd say to lay her down on her belly over there in that corner, out of the way, as close to that big hangar as you can work without blasting it out with your jets."

As Kinnison had intimated, the lightness of the vessel was indeed only seeming. Superbly and effortlessly the big boat seeped downward into the designated corner; but when she touched the pavement she did not stop. Still easily and without jar or jolt she settled—a full twenty feet into the concrete, reinforcing steel and hard-packed earth of the field before she came to a halt.

"What a monster! Who are they? Where could they have come from?" Kinnison caught a confusion of startled thoughts as the real size and mass of the visitor became apparent to the na-

tives. Then again came the clear thought of the officer.

"We would like very much to have you and as many as possible of your companions come to confer with us as soon as you have tested our atmosphere. Come in space-suits if you must."

The air was tested and found suitable. True, it did not match exactly that of Tellus, or Rigel IV, or Velantia; but then, neither did that of the *Dauntless,* since that gaseous mixture was a compromise one, and mostly artificial to boot.

"Worsel, Tregonsee, and I will go to this conference," Kinnison decided. "The rest of you sit tight. I don't need to tell you to keep on your toes, that anything is apt to happen, anywhere, without warning. Keep your detectors full out and keep your noses clean—be ready like the good little endeavorers you are, 'to do with all your might what your hands find to do.' Come on, fellows," and the three Lensmen strode, wriggled, and waddled across the field, to and into a spacious room of the Administration Building.

"Strangers, or, I should say friends, I introduce you to Wise, our president," Kinnison's acquaintance said, clearly enough, although it was plain to all three Lensmen that he was shocked at the sight of the Earthman's companions.

"I am informed that you understand our language—" the president began doubtfully.

He, too, was staring at Tregonsee and Worsel. He had been told that Kinnison, and therefore, supposed, the rest of the visitors, were beings fashioned more or less after his own pattern. But these two creatures!

FOR THEY were not even remotely human in form. Tregonsee, the Rigellian, with his leathery, multiappendaged, oil-drumlike body, his immobile dome of a head and his four blocky pillars of legs must at first sight have appeared fantastic indeed. And Worsel, the Velantian, was infinitely worse. He was repulsive, a thing materialized from sheerest nightmare—a leather-winged, crocodile-headed, crooked-armed, thirty-foot long, pythonish, reptilian monstrosity!

But the President of Medon saw at once that which the three outlanders had in common. The Lenses, each glowingly aflame with its own innate pseudo-vitality—Kinnison's clamped to his brawny wrist by a band of iridium-osmium-tungsten alloy; Tregonsee's embedded in the glossy black flesh of one mighty, sinuous arm; Worsel's apparently driven deep and with cruel force into the horny, scaly hide squarely in the middle of his forehead, between two of his weirdly stalked, repulsively extensible eyes.

"It is not your language we understand, but your thoughts, by virtue of these our Lenses which you have already noticed." The president gasped as Kinnison bulleted the information into his mind. "Go ahead. . . . Just a minute!" as an unmistakable sensation swept through his being. "We've gone *free!* The whole planet, I perceive. In that respect, at least, you are in advance of us. As far as I know, no scientist of any of our races has even thought of a Bergenholm big enough to free a world."

"It was long in the designing; many years in the building of its units," Wise replied. "We are leaving this sun in an attempt to escape from our enemy and yours; Boskone. It is our only chance of survival. The means have long been ready, but the opportunity which you have just made for us is the first that we have had. This is the first time in many, many years that not a single Boskonian vessel is in position to observe our flight."

"Where are you going? Surely the Boskonians will be able to find you if they wish."

"That is possible, but we must run that risk. We must have a respite or perish; after a long lifetime of continuous warfare, our resources are at the point of exhaustion. There is a part of this Galaxy in which there are very few planets, and of those few, none are inhabited or habitable. Since nothing is to be gained, ships seldom or never go there. If we can reach that region undetected, the probability is that we shall be unmolested long enough to recuperate."

Kinnison exchanged flashing thoughts with his two fellow Lensmen, then turned again to Wise.

"We come from a neighboring Galaxy," he informed him, and pointed out to his mind just which Galaxy he meant. "You are fairly close to the edge of this one. Why not move over to ours? You have no friends here, since you think that yours may be the only remaining independent planet. We can assure you of friendship. We can also give you some hope of peace—or at least semipeace—in the near future, for we are driving Boskonia out of our Galaxy."

"What you think of as 'semipeace' would be tranquillity incarnate to us," the old man replied with feeling. "We have, in fact, considered long that very move. We decided against it for two reasons: first, because we knew nothing about conditions there, and hence might be going from bad to worse; and second and more important, because of lack of reliable data upon the density of matter in inter-galactic space. Lacking that, we could not estimate the time necessary for the journey, and we could have no assurance that our sources of power, great as they are, would be sufficient to make up the heat lost by radiation."

"We have already given you an idea of conditions and we can give you the data you lack."

THEY DID so, and for a matter of minutes the Medonians conferred. Meanwhile Kinnison went on a mental expedition to one of the power plants. He expected to see supercolossal engines; bus bars ten feet thick, perhaps cooled in liquid helium; and other things in proportion. But what he actually saw made him gasp for breath and call Tregonsee's attention. The Rigellian sent out his sense of perception with Kinnison's, and he also was almost stunned.

"What's the answer, Trig?" the Earthman asked, finally. "This is more down your alley than mine. That motor's about the size of my foot, and if it isn't eating a thousand pounds an hour I'm Klono's maiden aunt. And the whole output is going out on two wires no bigger than number four, jacketed together like ordinary parallel pair. Perfect insulator? If so, how about switching?"

"That must be it, a substance of practically infinite resistance," the Rigellian replied absently, studying intently the peculiar mechanism. "Must have a better conductor than silver, too, unless they can handle voltages of ten to the fifteenth or so, and don't see how they could break such potentials. . Guess they don't use switches . don't see any must shut down the prime sources. . No, there it is—so small that I overlooked it completely. In that little box there! Sort of a jamplate type; a thin sheet of insulation with a knife on the leading edge, working in a slot to cut the two conductors apart—kills the arc by jamming into the tight slot at the end of the box. The conductors must fuse together at each make and burn away a little at each break, that's why they have renewable tips. Kim, they've really got something! I certainly am going to stay here and do some studying."

"Yes, and we'll have to rebuild the *Dauntless*—"

The two Lensmen were called away from their study by Worsel—the Medonians had decided to accept the invitation to attempt to move to the First Galaxy. Orders were given, the course was changed and the planet, now a veritable spaceship, shot away in the new direction.

"Not as many legs as a speedster, of course, but at that, she's no slouch—we're making plenty of lights," Kinnison commented, then turned to the president. "It seems rather presumptuous for us to call you simply 'Wise,' especially as I gather that that is not really your formal name—"

"That is what I am called, and that is what you are to call me," the oldster replied. "We of Medon do not have names. Each has a number; or, rather, a symbol composed of numbers and letters of our alphabet—a symbol which gives his full classification. Since these things are too clumsy for regular use, however, each of us is given a nickname, usually an adjective, which is supposed to be more or less descriptive. You of Earth we could not give a complete symbol, your two companions we could not give any at all. However, you may be interested in knowing that you three have already been named?"

"Very much so."

"You are to be called 'Keen.' He of Rigel IV is 'Strong,' and he of Velantia is 'Agile.'"

"Quite complimentary to me, but—"

"Not bad at all, I'd say," Tregonsee broke in. "But hadn't we better be getting on with more serious business?"

"We should indeed," Wise agreed. "We have much to discuss with you; particularly the weapon you used."

"Could you get an analysis of it?" Kinnison asked, sharply.

"No. No one beam was in operation long enough. However, a study of the recorded data, particularly the figure for intensity—figures so high as to be almost unbelievable—lead us to believe that the beam is the result of an enormous overload upon a projector otherwise of more or less conventional type. Some of us have wondered why we did not think of the idea ourselves—"

"So did we, when it was used on us," Kinnison grinned and went off to explain the origin of the primary. "But before we go into details, I noticed that your fixed-mount stuff could not work effectively through atmosphere. We have what we call Q-type helices, with which we incase such beams so that they work in a tube of vacuum. We will give you the Q-formulæ and also the working hookup—including the protective devices, because they're mighty dangerous without plenty of force-backing—of the primaries, in exchange for some lessons in power-plant design."

"Such an exchange of knowledge would be helpful indeed," Wise agreed.

"The Boskonians know nothing whatever of this beam, and we do not want them to learn of it," Kinnison cautioned. "Therefore I have two suggestions to make. First, that you try everything else before you use this primary beam. Second, that you don't use it even then unless you can wipe out, as nearly simultaneously as we did out there, every Boskonian who may be able to report back to his base as to what really happened. Fair enough?"

"Eminently so. We agree without reservation—it is to our interest as much as yours that such a secret be kept from Boskone."

"QX. Fellow, let's go back to the ship for a couple of minutes." Then, aboard the *Dauntless:* "Tregonsee, you and your crew want to stay with the planet, to show the Medonians what to do and to help them along generally, as well as to learn about their power system. Thorndyke, you and your gang, and probably Lensman Hotchkiss, had better study these things, too—you'll know what you want as soon as they show you the hookup. Worsel, I'd like

to have you stay with the ship. You're in command of her until further orders. Keep her here for, say, a week or ten days, until the planet is well out of the Galaxy. Then, if Hotchkiss and Thorndyke haven't got all the dope they want, leave them here to ride back with Tregonsee on the planet and drill the *Dauntless* for Tellus. Keep yourself more or less disengaged for a while, and sort of keep tuned to me. I may not need an ultra-long-range communicator, but you never can tell."

"Why such comprehensive orders, Kim?" asked Hotchkiss. "Who ever heard of a commander abandoning his expeditions? Aren't you sticking around?"

"Nope—got to do a flit. Think maybe I'm getting an idea. Break out my speedster, will you, Allerdyce?"—and the Gray Lensman was gone.

V.

KINNISON'S speedster shot away and made an undectable, uneventful voyage back to the Earth. In due time, therefore, the Gray Lensman was again closeted with Port Admiral Haynes.

"Why the foliage?" the chief of staff asked, almost at sight, for the Gray Lensman was wearing a more-than-half-grown beard.

"I may need to be Chester Q. Fordyce for a while. If I don't, I can shave it off quick. If I do, a real beard is a lot better than an imitation," and he plunged into his subject.

"Very fine work, son, very fine indeed," Haynes congratulated the younger man at the conclusion of his report. "We shall begin at once, and be ready to rush things through when the technicians bring back the necessary data from Medon. But there's one more thing I want to ask you. How did you come to place those spotting-screens so exactly? The beam practically dead-centered them. You said that it was surmise and suspicion before it happened, but I thought then and still think that you had a much firmer foundation than any kind of a mere hunch. What was it?"

"Deduction, based upon an unproved, but logical, cosmogonic theory—but you probably know more about that stuff than I do."

"Highly improbable. I read just a smattering now and then of the doings of the astronomers and astrophysicists. I didn't know that that was one of your specialties, either."

"It isn't, but I had to do a little cramming. We'll have to go back quite a while to make it clear. You know, of course, that a long time ago, before even interplanetary ships were developed, the belief was general that not more than about four planetary solar systems could be in existence at any one time in the whole Galaxy?"

"Yes, I am familiar with that belief—a consequence of the binary-dynamic-encounter theory in a too-limited application. The theory itself is still good, isn't it?"

"Eminently so—every other theory is wrecked by its failure to account for the quantity and above all, the distribution, of angular momentum of planetary systems. But you know what I'm going to say—that 'limited application' proves it!"

"No, just let's say that a bit of light is beginning to dawn. Go ahead."

"QX. Well, when it was discovered that there were millions of times as many planets in the Galaxy as could be accounted for by a dynamic encounter occurring once in two times ten to the tenth years or so, some way had to be figured out to increase, millionfold, the number of such encounters. Manifestly, the random motion of the stars within the Galaxy could not account for it. Neither could the vibration or oscillation of the globular clusters through the Galaxy. The meeting of two Galaxies—

the passage of them completely through each other, edgewise—would account for it very nicely. It would also account for the fact that the solar systems on one side of the Galaxy tend to be somewhat older than the ones on the opposite side. Question; find the Galaxy. It was van der Schleiss, I believe, who found it. Lundmark's Nebula. It is edge on to us, with a receding velocity of twelve hundred and forty-six miles per second—the exact velocity which, corrected for gravitational decrement, will put Lundmark's Nebula right here at the time when, according to our best geophysicists and geochemists, old Earth was being born. If that theory was correct, Lundmark's Nebula should also be full of planets. Four expeditions went out to check the theory, and none of them came back. We know why, now—Boskone got them. We got back, because of you, and only you."

"Holy Klono!" the old man breathed, paying no attention to the tribute. "It checks—*how* it checks!"

"To nineteen decimals."

"BUT STILL it doesn't explain why you set your traps on that line."

"Sure it does. How many Galaxies are there in the Universe, do you suppose, that are full of planets?"

"Why, all of them I suppose—or no, not so many perhaps—I don't know—I don't remember of having read anything on that question."

"No, and you probably won't. Only loose-screwed space detectives, like me, and crackpot science-fiction writers, like Wacky Willison, have noodles vacuous enough to harbor such thin ideas. But, according to our admittedly highly tenuous reasoning, there are only two such Galaxies—Lundmark's Nebula and ours."

"Huh? Why?" demanded Haynes.

"Because Galaxies don't collide much, if any, oftener than binaries within a Galaxy do," Kinnison asserted. "True, they are closer together in space, relative to their actual linear dimensions, than are stars; but on the other hand, their relative motions are slower—that is, a star will traverse the average interstellar distance much quicker than a Galaxy will the inter-galactic one—so that the whole thing evens up. As nearly as Wacky and I could figure it, two Galaxies will collide deeply enough to produce a significant number of planetary solar systems on an average of once in just about one point eight times ten to the tenth years. Pick up your slide rule and check me on it, if you like."

"I'll take your word for it," the old Lensman murmured absently. "But any Galaxy probably has at least a couple of solar systems all the time—but I see your point. The probability is overwhelmingly great that Boskone would be in a Galaxy having hundreds of millions of planets rather than in one having only a dozen or less inhabitable worlds. But at that, they *could* all have lots of planets. Suppose that our wilder thinkers are right, that Galaxies are grouped into Universes, which are spaced, roughly, about the same as the Galaxies are. Two of *them* could collide, couldn't they?"

"They could, but you're getting 'way out of my range now. At this point the detective withdraws, leaving a clear field for you and the science-fiction imaginationeer."

"Well, finish the thought—that I'm wackier even than he is!" Both men laughed, and the Port Admiral went on: "It's a fascinating speculation—it does no harm to let the fancy roam at times—but at that, there are things of much greater importance. You think, then, that the thionite ring enters into this matrix?"

"Bound to. Everything ties in. The most intelligent races of this Galaxy are oxygen-breathers, with warm, red blood: the only kind of physique which thionite

affects. The more of us who get the thionite habit, the better for Boskone. It explains why we have never got to the first check station in getting any of the real higher-ups in the thionite game; instead of being an ordinary criminal ring they've got all the brains and all the resources of Boskonia back of them. But if they are that big—and as good as we know they are—I wonder why—" Kinnison's voice trailed off into silence; his brain raced.

"I WANT to ask you a question that is none of my business," the young Lensman went on almost immediately, in a voice strangely altered. "Just how long ago was it that you started losing

A throttling hand clamped over her mouth even as she awoke, and in the same instant her thought-screen flicked off.

fifth-year men just before graduation? I mean, that boys sent to Arisia to be measured for their Lenses supposedly never got there? Or at least, they never came back and no Lenses were ever received for them?"

"About ten years. Twelve, I think, to be ex—" Haynes broke off in the middle of the word and his eyes bored into those of the younger man. "What makes you think that there were any such?"

"Deduction again, but this time I know that I'm right. At least one every year. Usually two or three."

"Right, but there have always been space accidents . . . or they were caught by the pirates . . . you think, then, that—"

"I don't think. I *know!*" Kinnison declared. "They got to Arisia, *and they died there.* All I can say is, thank God for the Arisians! We can still trust our Lenses; they are seeing to that."

"But why didn't they tell us?" Haynes asked, perplexed.

"They wouldn't; that isn't their way," Kinnison stated, flatly and with conviction. "They have given us an instrumentality, the Lens, by virtue of which we should be able to do the job, and they are seeing to it that that instrumentality remains untarnished. If we cannot handle it properly, that is our lookout. We've got to fight our own battles and bury our own dead. Now that we have smeared up the enemy's military organization in this Galaxy by wiping out Helmuth and his headquarters, the drug syndicate seems to be my best chances of getting a line on the real Boskone. While you are mopping up and keeping them from establishing another war base here, I think I'd better be getting at it, don't you?"

"Probably so—you know your own oysters best. Mind if I ask where you're going to start in?" Haynes looked at Kinnison quizzically as he spoke. "Have you deduced that, too?"

The Gray Lensman returned the look in kind. "No. Deduction couldn't take me quite that far," he replied in the same tone. "You are going to tell me that, when you get around to it."

"Me? Where do I come in?" the Port Admiral feigned surprise.

"As follows. Helmuth probably had nothing to do with the dope running, so its organization must still be intact. If so, they would take over as much of the other branch as they could get hold of, and hit us harder than ever. I haven't heard of any unusual activity around here, so it must be somewhere else. Wherever it is, you would know about it, since you are a member of Galactic Council; and Councillor Ellington, in charge of Narcotics, would hardly take any very important step without conferring with you, as port admiral and chief of staff. How near right am I?"

"ON THE center of the beam, all the way—your deducer is blasting at maximum," Haynes said, in admiration. "Radelix is the worst—they're hitting it mighty hard. We sent a full unit over there last week. Shall we recall them, or do you want to work independently?"

"Let them go on; I'll be of more use working on my own, I think. I did the boys over there a favor a while back—they would co-operate anyway, of course, but it's a little nicer to have them sort of owe it to me. We'll all be able to play together very nicely if the opportunity arises."

"I'm mighty glad you're taking this on. The Radeligians are stuck, and we had no real reason for thinking that our men could do any better. With this new angle of approach, however, and with you working behind the scenes, the picture looks entirely different."

"I'm afraid that's unjustifiably high—"

"Not a bit of it, lad. Just a minute

—I'll break out a couple of beakers of fayalin— Luck!"

"Thanks, chief!"

"Down the hatch!" and again the Gray Lensman was gone. To the spaceport, into his speedster, and away—hurtling through the void at the maximum blast of the fastest space-flier then boasted by the Galactic Patrol.

During the long trip, Kinnison exercised, thought, and studied spool after spool of tape—the Radeligian language. Thoughts of the red-headed nurse obtruded themselves strongly at times, but he put them aside resolutely. He was, he assured himself, off women forever—all women. He cultivated his new beard; trimming it, with the aid of a triplex mirror and four stereoscopic photographs, into something which, although neat and spruce enough, was too full and bushy by half to be a Vandyke. Also, he moved his Lens bracelet up his arm and rayed the white skin thus exposed until his whole wrist was the same even shade of tan.

He did not drive his speedster to Radelix, for that racy little fabrication would have been recognized anywhere for what she was; and private citizens simply did not drive ships of that type. Therefore, with every possible precaution of secrecy, he landed her in a Patrol base four solar systems away. In that base Kimball Kinnison disappeared; but the tall, shock-haired, bushy-bearded Chester Q. Fordyce—cosmopolite, man of leisure, and dilettante in science—who took the next space liner for Radelix was not precisely the same individual who had come to that planet a few days before with that name and those unmistakable characteristics.

Mr. Chester Q. Fordyce, then, and not Gray Lensman Kimball Kinnison, disembarked at Ardith, the world-capital of Radelix. He took up his abode at the Hotel Ardith-Splendide and proceeded, with neither too much nor too little fanfare, to be his cosmopolitan self in those circles of society in which, wherever he might find himself, he was wont to move.

As a matter of course, he entertained, and was entertained by, the Tellurian Ambassador. Equally as a matter of course, he attended divers and sundry functions, at which he made the acquaintance of hundreds of persons, many of them personages. That one of these should have been Vice Admiral Gerrond, Lensman in charge of the Patrol's Radeligian base, was inevitable.

IT WAS, then, a purely routine and logical development that at a reception one evening Vice Admiral Gerrond stopped to chat for a moment with Mr. Fordyce; and it was purely accidental that the nearest bystander was a few yards distant. Hence, Mr. Fordyce's conduct was strange enough.

"Gerrond!" he said without moving his lips and in a tone almost inaudible, the while he was offering the Admiral an Alsakanite cigarette. "Don't look at me particularly right now, and don't show surprise. Study me for the next ten minutes, then put your Lens on me and tell me whether you have ever seen me before or not." Then, glancing at the watch upon his left wrist—a timepiece just about as large and as ornate as a wrist watch could be and still remain in impeccable taste—he murmured something conventional and strolled away.

The ten minutes passed and he felt Gerrond's thought. A peculiar sensation, this, being on the receiving end of a single beam, instead of using his own Lens.

"As far as I can tell, I have never seen you before. You are certainly not one of our agents, and if you are one of Haynes' whom I have ever worked with you have done a wonderful job of disguising. I must have met you some-

where, sometime, else there would be no point to your question; but beyond the evident—and admitted—fact that you are a white Tellurian, I can't seem to place you."

"Does this help?" This question was shot through Kinnison's own Lens.

"Since I have known so few Tellurian Lensmen it tells me that you must be Kinnison, but I do not recognize you at all readily. You seem changed—older—besides, who ever heard of an Unattached Lensman doing the work of an ordinary agent?"

"I am both older and changed—partly natural and partly artificial. As for the work, it's a job that no ordinary agent can handle—it takes a lot of special equipment—"

"You've got *that*, indubitably! I get goose-flesh yet every time I think of that trial."

"You think that I'm proof against recognition, then, as long as I don't use my Lens?" Kinnison stuck to the issue.

"Absolutely so. You're here, then, on thionite?" No other issue, Gerrond knew, could be grave enough to account for this man's presence. "But your wrist? I studied it. You can't have worn your Lens there for months—those Tellurian bracelets leave white streaks an inch wide."

"I tanned it with a pencil beam. Nice job, eh? But what I want to ask you about is a little co-operation. As you supposed, I'm here to work on this drug ring."

"Surely—anything we can do. But Narcotics is handling that, not us—but you know that, as well as I do—" the officer broke off, puzzled.

"I know. That's why I want you—that and because you handle the secret service. Frankly, I'm scared to death of leaks. For that reason I'm not saying anything to anyone except Lensmen, and I'm having no dealings with anyone connected with Narcotics. I have as unimpeachable an identity as Haynes could furnish—"

"There's no question as to its adequacy, then," the Radeligian interposed.

"I would like to have you pass the word around among your boys and girls that you know who I am and that I'm safe to play with. That way, if Boskone's agents spot me, it will be for an agent of Haynes, and not for what I really am. That's the first thing. Can do?"

"Easily and gladly. Consider it done. Second?"

"To have a boatload of good, tough marines on hand if I should call you. There are some Velarians coming over later, but I may need help in the meantime. I may want to start a fight—quite possibly even a riot."

"They'll be ready, and they'll be big, tough, and hard. Anything else?"

"NOT JUST now, except for one question. You know Countess Avondrin, the woman I was dancing with a while ago. Got any dope on her?"

"Certainly not—what do you mean?"

"Huh? Don't you know even that she's a Boskonian agent of some kind?"

"Man, you're crazy! She isn't an agent, she can't be. Why, she's the daughter of a Planetary Councillor, the wife of one of our most loyal officers."

"She would be. That's the type they like to get hold of."

"Prove it!" the Admiral snapped. "Prove it or retract it!" He almost lost his poise, almost looked toward the distant corner in which the bewhiskered gentleman was sitting so idly.

"QX. If she isn't an agent, why is she wearing a thought-screen? You haven't tested her, of course."

Of course not. The amenities, as has been said, demanded that certain reserves of privacy remain inviolate. The Tellurian went on: "You didn't, but I did. On this job I can recognize noth-

ing of good taste, of courtesy, of chivalry, or even of ordinary common decency. I suspect *everyone* who does not wear a Lens."

"A thought-screen!" exclaimed Gerrond. "How could she, without armor?"

"It's a late model—brand new. Just as good and just as powerful as the one I myself am wearing," Kinnison explained. "The mere fact that she's wearing it gives me a lot of highly useful information."

"What do you want me to do about her?" the Admiral asked. He was mentally asquirm, but he was a Lensman.

"Nothing whatever—except possibly, for our own information, to find out how many of her friends have become thionite-sniffers lately. If you do anything, you may warn them, although I know nothing definite about which to caution you. I'll handle her. Don't worry too much, though; I don't think she's anybody we really want. Afraid she's small fry—no such luck as that I'd get hold of a big one so soon."

"I hope she's small fry." Gerrond's thought was a grimace of distaste. "I hate Boskonia as much as anybody does, but I don't relish the idea of having to put that girl into the Chamber."

"If my picture is half right she can't amount to much," Kinnison replied. "A good lead is the best I can expect. I'll see what I can do."

For days, then, the searching Lensman pried into minds: so insidiously that he left no trace of his invasions. He examined men and women, of high and of low estate. Waitresses and ambassadors, flunkies and bankers, ermined prelates and truck drivers. He went from city to city. Always, but with only a fraction of his brain, he played the part of Chester Q. Fordyce; ninety-nine percent of his stupendous mind was probing, searching and analyzing. Into what charnel pits of filth and corruption he delved, into what fastnesses of truth and loyalty and high courage and ideals, must be left entirely to the imagination; for the Lensman never has spoken and never will speak of these things.

He went back to Ardith and, late at night, approached the dwelling of Count Avondrin. A servant arose and admitted the visitor, not knowing then or ever that he did so. The bedroom door was locked from the inside, but what of that? What resistance can any mechanism offer to a master craftsman, plentifully supplied with tools, who can perceive every component part, however deeply buried?

The door opened. The countess was a light sleeper, but before she could utter a single scream one powerful hand clamped her mouth, another snapped the switch of her supposedly carefully concealed thought-screen generator. What followed was done very quickly.

Mr. Fordyce strolled back to his hotel and Lensman Kinnison directed a thought at Vice Admiral Gerrond.

"Better fake up some kind of an excuse for having a couple of guards or policemen in front of Count Avondrin's town house at eight twenty-five this morning. The countess is going to have a brainstorm."

"What *have* . . . what will she do?" Gerrond mastered his emotions sufficiently to keep from swearing.

"Nothing much. Scream a bit, rush out of doors half dressed, and fight anything and everybody that touches her. Warn the officers that she'll kick, scratch, and bite. There are plenty of signs of a prowler having been in her room, but if they can find him they're good—*very* good. She'll have all the signs and symptoms, even to the puncture, of having been given a shot in the arm of some brand-new drug, which the doctors won't be able to find or to identify. But there will be no question raised of insanity or of any other per-

manent damage—she'll be right as rain in a couple of months."

"Oh, that mind-ray machine of yours again, eh? And that's all you're going to do to her?"

"That's all. I can let her off easy and still be just, I think. She's helped me a lot. She'll be a good girl from now on, too; I've thrown a scare into her that will last her the rest of her life."

"Thanks, Gray Lensman! What else?"

"I'd like to have you at the Tellurian Ambassador's Ball day after tomorrow, if it's convenient."

"I've been planning on it, since it's on the 'must' list. Shall I bring anything or anyone special?"

"No. I just want you on hand to give me any information you can on a person who will probably be there to investigate what happened to the countess."

"I'll be there," and he was.

IT WAS a gay and colorful throng, but neither of the two Lensmen was in any mood for gaiety. They acted, of course. They neither sought nor avoided each other but, somehow, they were never alone together.

"Man or woman?" asked Gerrond.

"I don't know. All I've got is the recognition."

The Radeligian did not ask what that recognition was to be. He knew that that information might prove dangerous indeed to any unauthorized possessor. He did not want to know it; he was glad that the Tellurian had not thrust it upon him.

Suddenly the Vice Admiral's attention was wrenched toward the doorway, to see the most marvelously, the most flawlessly beautiful woman he had ever seen. But not long did he contemplate that beauty, for the Tellurian Lensman's thoughts were fairly seething, despite his iron control.

"Do you mean . . . you can't mean—" Gerrond faltered.

"Yes—definitely!" Kinnison rasped. "She looks like an angel, but take it from me, *she isn't.* She's one of the slimiest snakes that ever lived—she's so low that she could put on a tall silk hat and walk under a duck. I know she's beautiful. She's a riot, a seven-sector callout, a thionite dream. So what? She is also Dessa Desplaines, formerly of Aldebaran II. Does that mean anything to you?"

"Not a thing, Kinnison."

"She's in it, clear to her neck. I had a chance to wring her neck once, too, damn it all, and didn't. She's got a brazen crust, coming here now, with all our Narcotics on the job— Wonder if they think they've got Enforcement so badly whipped that they can get away with stuff as rough as this— Sure you don't know her, or know of her?"

"I never saw her before, or heard of her."

"Perhaps she isn't known, out this way. Or maybe they think they're ready for a show-down . . . or don't care. Her being here ties me up hand and foot, anyway. *She'll* recognize me, for all the tea in China. Gerrond! You know the Narcotics' Lensmen, don't you?"

"Certainly."

"Call one of them right now. Tell him that Dessa Desplaines, the zwilnik* houri, is right here on the floor— What! He doesn't know her, either! And none of our boys are Lensmen! Make it a three-way. Lensman Winstead? Kinnison of Sol III—unattached. Sure that none of you recognize this picture?" and he transmitted a perfect image of the ravishing creature then moving regally across the floor. "Nobody does? Good! Maybe that's why she's here, after all —thinks she can get away with it.

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* Zwilnik;—any person connected with the illicit drug traffic. E. E. S.

Anyway, she's your meat. Here's the chance for a real capture. Come and get her."

"You will appear against her, of course?"

"If necessary—but it won't be necessary. As soon as she sees that the game's up, all hell will be out for noon."

AS SOON as the connection had been broken, Kinnison realized that the thing could not be done that way; that he could not stay out of it. No man alive save himself could prevent her from flashing a warning—badly as he hated it, he had to do it. Gerrond glanced at him curiously: he had received a few of those racing thoughts.

"Tune in on this," Kinnison grinned wryly. "If the last meeting I had with her is any criterion, it ought to be good. S'pose anybody around here understands the language of Aldebaran II?"

"Never heard it mentioned if they do."

The Tellurian walked blithely up to the radiant visitor, held out his hand in Earthly—and Aldebaranian—greeting, and spoke: "Madam Desplaines would not remember Chester Q. Fordyce, of course. It is of the piteousness that I should be so accursedly of the ordinariness; for to see madam but the one time, as I did at the New Year's ball in High Altamont, is to remember her forever."

"Such a flatterer!" The woman laughed. "I trust that you will forgive me, Mr. Fordyce, but one meets so many interesting—" Her eyes widened in surprise, an expression which changed rapidly to one of flaming hatred, not unmixed with fear.

"So you do recognize me, you bedroom-eyed, Aldebaranian hell-cat," he remarked, evenly. "I rather expected that you would."

"Yes, you sweet, uncontaminated sissy, you overgrown super-Boy Scout, I do," she hissed, malevolently, and made a quick motion toward her corsage. These two, as has been intimated, were friends of old.

Quick though she was, the man was quicker. His left hand darted out to seize her left wrist; his right, flashing around her body, grasped her right and held it rigidly in the small of her back. Thus they walked away.

"Stop!" she flared. "You're making a spectacle of me!"

"Now isn't that something to worry about?" His lips smiled, for the benefit of the observers, but his eyes held no glint of mirth. "These folks will think that this is the way all Aldebaranian friends walk together. If you think for a second that I'm going to give you a chance to touch that sounder you're wearing you haven't got the sense of a Zabriskan fontema. Stop wriggling!" he counseled, sharply. "Even if you can do enough hula-hula shimmying to work it, before it contacts once I'll crush your brain to a pulp, right here and right now!"

Outside, in the grounds, "Oh, Lensman, let's sit down and talk this over!" and the girl brought into play everything she had. It was a distressing scene, but it left the Lensman cold.

"Save your breath," he advised her finally, wearily. "To me you're just another zwilnik, no more and no less. A female louse is still a louse; and calling a zwilnik a louse is sheerest flattery."

He said that; and, saying it, knew it to be the exact and crystal truth: but not even that knowledge could mitigate in any iota the recoiling of his every fiber from the deed which he was about to do. He could not even pray, with immortal Merritt's *Dwayanu:*

"Luka—turn your wheel so I need not slay this woman!"

It had to be. Why in all the nine hells of Valaria did he have to be a Lensman?

Why did he have to be the one to do it? But it had to be done, and soon; they'd be here shortly.

"There's just one thing you can do to make me believe that you're even partially innocent," he ground out, "that you have even one decent thought or one decent instinct anywhere in you."

"What is that, Lensman? I'll do it, whatever it is!"

"Release your thought-screen and send out a call to the Big Shot."

The girl stiffened. This big cop wasn't so dumb—he really *knew* something. He must die, and at once. How could she get word to—

Simultaneously Kinnison perceived that for which he had been waiting; the Narcotics men were coming.

He tore open the woman's gown, flipped the switch of her thought-screen, and invaded her mind. But, fast as he was, he was late—almost too late altogether. He could get neither direction line nor location; but only, and faintly, a picture of a space-dock saloon, of a repulsively obese man in a luxuriously furnished back room. Then her mind went completely blank and her body slumped down, bonelessly.

Thus Narcotics found them; the woman inert and flaccid upon the bench, the man staring down at her in black abstraction.

END PART ONE.

SPACE RATING

By JOHN BERRYMAN

SPACE RATING

It will take young men with instant-fast reaction time to fly the spaceships of the future!

By John Berryman

Illustrated by Kramer

MAJOR PHIL HAWLEY put his notes down, stood up and walked around his desk. Hands clasped behind his back, he rocked precariously on the balls of his feet at the edge of the lecture platform. His ramrod posture and impeccable uniform added height to his scant five-feet-nine.

"The hour is almost up, gentlemen," he said, "and I prefer to start the next topic with a whole lecture period before me, so that this will be all for today."

As thirty uniformed students picked up note pads preparatory to leaving, the major brought them all back to conscientious attention with the words, "There are a few remarks, however, which I might make prior to tomorrow's lecture, with the purpose of acquainting you with the topic and perhaps suggesting a little preparatory reading tonight."

He squared his shoulders and began to pace back and forth before the desk, saying academically: "The theory of navigation at velocities in excess of the speed of light has in the past been a very indefinite body of doctrine. Recently mathematical techniques have been devised to deal with the peculiar difficulties inherent in the case, and definitive results have been secured. The most important point brought out by the definitive solution of problems hitherto regarded as insoluable mathematically is that most of the presumptions of earlier theory have been borne out. If at all, general conclusions have been altered not in direction, but merely in degree."

With an alacrity that suggested he had expected it, Hawley recognized an objecting hand. He called on the student. "Lieutenant Riggs?"

"Sir," the tall blond objector said, "I've always been under the impression that mathematical methods had never been completed to deal with this problem. Three-dimensional propositions can at best afford only analogies and approximations to problems that by their nature must be solved by four dimensional techniques. As I understand it, our knowledge of four-dimensional propositions in vector analysis and quantum mechanics is too incomplete to give definitive solutions."

The instructor smiled and leaned against the polished walnut of his desk. "On the contrary, Lieutenant Riggs," he said smoothly, running a hand over his black hair, "as I said before, recent contributions to mathematical theory have given definitive solutions."

Riggs did not bother to raise his hand again, but asked, with arch politeness: "May I quote from the Manual?"

At Hawley's smiling nod Riggs picked up the thick, blue-bound volume prepared by the scientists of the Space Patrol for classroom use, and riffled its pages before finding his place. He looked up and then read a few lines:

"Theorizing on problems of navigation at speeds in excess of that of light can at best give presumptions; strong presumptions, of course, but definitive results are, by the very nature of the problem, unattainable."

He closed the book slowly and stared at the waiting instructor, eyebrows raised in question. The class was utterly silent, watching the latest development in what had long since become a classroom feud between Hawley and his most able pupil.

The major seemed puzzled. "Does the Manual really say that, Lieutenant Riggs?" he asked, his voice slightly touched with anxiety.

"Yes, sir," Riggs replied, trying to keep his voice calm.

The class held its breath, half-sensing what was coming. Hawley leaned his head a little to one side, as if considering the statement, and nodded slightly to himself. Then he leaned forward, his black eyes snapping, and winked confidentially at his heckler. "I'll have it changed, lieutenant," he said softly.

As the classroom burst into laughter, Hawley stepped down off the platform and called: "That's all for today, gentlemen."

Riggs, his face flaming red, rose stiffly from his seat and walked out with the rest.

IN THE corridor outside, Riggs' roommate joined him. "Going back to the room, Bo?" he asked his still incandescent companion.

Riggs grunted an affirmative, then walked several paces in silence. "Damn that Hawley anyway!" he swore suddenly.

Mal Burt laughed. "He does bear down on you a little, Bo," he chuckled. "I thought I'd die when he told you he'd have the Manual changed!"

Riggs' lip curled as he half-snarled: "Oh, I suppose he has worked out some fourth-dimensional equations, all right, he's the hottest mathematical theoretician in the Patrol, but he doesn't have to rub it in. How was I to know?" Both lieutenants saluted absently as a brace of passing undergraduate privates snapped hands to foreheads.

Burt continued to laugh as they walked across the paved court toward their barracks. "I guess we all feel the same way about the old boy. He sure lets you know he doesn't think much of your mental capacity."

Riggs flared up again as they turned into the walk leading to the long translucent building where they lived. "Why, hell, it's just his inferiority complex. He feels funny about being short, that's all. That's the only reason he keeps on trying out for his space rating year after year. He likes to wave it in front of us. It makes him think he's better than he knows he is. The dope."

Burt looked over at his roommate. "Well, I don't know. You can't blame him much for being proud of that. He's the oldest man ever to hold a rating. Most pilots are washed out five years before his time. He must be thirty-five by now."

"Sure, sure, I know. It's remarkable for a man to keep his responses, and all that, but it's the way he does it. I know damned well he was baiting me there in class today. He didn't need to start the lecture on supra-light velocities till tomorrow. He knew I'd be the only one in the class who'd challenge the statement about a definite solution. I can just see him now, the smug little martinet, laughing at the way I leaped at it!" He growled disgusted sounds in the back of his throat.

"Well," Burt said, as the two trotted up the steps of the barracks, saluting automatically again, "there's only two more weeks of this. We'll be back on patrol June 15th, Bo. I'll be just as glad as you to get Hawley off my back."

Scarcely had the two entered their severe quarters and thrown themselves into chairs when there was a rap on the door. At Riggs' command the one outside entered.

An orderly snapped a smart salute and said tonelessly: "Commander Conklin's compliments, Lieutenant Riggs, and will you report at once to his office."

Riggs nodded and dismissed the sergeant. He looked over at Burt. "What now, Mal?" he asked.

Burt shook his head. "Better snap it up," he advised. "Conk doesn't like to wait."

With one quick glance at his appearance, Riggs left for the office of the base commander, highest military officer at the Patrol's terrestrial base.

HE PAUSED at a door marked, "Major General Conklin, Base Commander," pulled his chin and stomach in before rapping smartly. He entered at the commander's order and saluted, standing at attention.

Conklin, grizzled veteran of many a patrol, shot him a piercing glance, then said: "Oh, yes, Lieutenant Riggs. At ease, lieutenant."

Conklin reached over to a basket and picked up several sheets of typed paper. "You're leaving on patrol duty in two weeks," the commander announced. "This is to notify you of your temporary promotion to the rank of captain, for the ninety-day duration of the patrol."

Riggs blinked at the unexpected news, and managed to gurgle, "Yes, sir."

Conklin laid the paper down and leaned forward. "This is also to notify you, Captain Riggs, that you have been selected as examiner for your alternate pilot when on patrol. You, of course, know the obligation of keeping this appointment absolutely confidential."

"Yes, sir," Riggs said again.

"You've been promoted, captain, so that you may be first officer and copilot. You are to observe the technique of your superior officer at the controls and decide whether his space rating should be continued for another year." He looked up at the erect figure before him. "Major Hawley will be in command." He said, noticing Riggs' start as he did so. "I don't need to tell you that your mission will be of more than usual delicacy, and for reasons that I don't have to bring up at this time."

He paused for a moment, while Riggs' whirling mind reflected that "unusual delicacy" was hardly the epithet. Examiner for Philo Hawley! What an assignment!

"You are to leave on June 15th for a patrol of ninety days," Conklin went on, "your activities to consist of servicing thirty robot observatories en route, collecting and examining their plates. You'll be informed of your ship later." The commander handed Riggs' orders across the desk. "That's all, captain," he said.

Riggs saluted. "Sir," he said diffidently, "may I have a few words with you, off the record?"

"Certainly. Go ahead."

"Well, sir, much as I appreciate this temporary promotion, and a chance to show that I deserve it, I think it only fair to make clear that I may be a rather poor choice for examiner. Major Hawley and I don't get along very well together. To be frank, we don't get along at all, and I'm afraid I would be rather prejudiced."

Conklin leaned back in his swivel chair and laughed. "Well, Riggs," he chuckled, "I don't know whom I could have selected from his classes who would not have felt the same way. Hawley's classroom technique is just a little this side of brutal, but I think you'll find him a very good man to work under on patrol. As a matter of fact, I have reason to believe that Hawley respects you as much as any of his students. I

don't think you'll have any undue difficulty. I'm glad you had the honesty to admit your bias, captain," he said in conclusion.

Riggs saluted. "Thank you, sir," he said. "I'll do my best."

At a nod from Conklin Riggs turned smartly on his heel and left, exceedingly puzzled by Conklin's tacit statement that Hawley had given him good marks and a good recommendation for his work in Navigational Theory.

THE NEXT two weeks flew by with unwonted rapidity, and Riggs found himself assigned, as he had been informed in advance he would be, to one of the ships in the Service Fleet, or, as it was familiarly known in the Patrol, the "Little Fleet." The name was derived from the fact that each member of the Service Fleet had the adjective "Little" prefixed to is name. Riggs' ship was the *Little Falls,* laden with fuel for the atomic motors of the robot observatories planted on thirty different planets of several nearby suns, and a huge supply of photographic plates to replenish the nearly exhausted magazines of the telescopic cameras.

Placed in many cases on planets where men could not have survived continued existence, the observatories on the planets of the nearer stars were serviced once every three terrestrial years. The exposed plates from the telescopes were removed, developed in the service ship as it sped through the endless wastes of space to its next destination, and run through moving-picture cameras to detect any astronomical occurrences recorded on them.

Since most of the cameras exposed plates only every few days, or at the most, a small number a day, it was a matter of but little time to run the film at projection speed through a moving-picture projector and look for such novæ and comets as were recorded in the interval. The more detailed graphs collected by cosmic-ray detectors, and so on, were brought back to Earth for more careful and detailed scrutiny by specialized experts.

Six days out from Earth found the *Little Falls* decelerating as it approached Rigel VI, its crew of ten protected from instant annihilation by the inertia screens, screens that permit humans to survive accelerations so stupendous that the stars were brought within easy reach of the Solar System. The crew had become acquainted by that time, for all except Hawley and Riggs had been virtual strangers. The general policy of the Patrol was to shift personnel around so that every man became acquainted with as many different duties as possible, and further, so that technical experts such as cosmic-ray specialists should have firsthand knowledge of as many parts of the Galaxy as possible.

In the control room, watching Rigel VI and its four smallish planets loom larger in the visiplate, were the four men responsible for the navigation and piloting of the spaceship: Hawley, commander and pilot; Riggs, first officer and co-pilot; Art Price, computer, and Tom Mercer, navigator.

Hawley and Riggs sat silently side by side at the dual controls. Mercer and Price, behind the pilots, faced each other across the twin calculators, determining their position by repeated observations through the low-powered telescope, and charting their course for landing.

Hawley looked across to Riggs, who was trying to make his twenty-four years look sufficiently dignified to justify his rank. "You take this one," the commander said, "I'm a little stale, I haven't shot a landing in nine months."

"Yes, sir," Riggs replied, wondering whether Hawley would keep pushing the landings off on him. They were approaching the second planet of the greenish sun, a barren orb, with no atmos-

phere to complicate the landing. Price and Mercer had already located the observatory, on the light side of the planet, and were calculating their position, both calculating machines alternately clicking and whirring as the co-ordinates of position were entered and run off.

As the time grew close for him to make his approach, Riggs closed the face-plate on the helmet of his spacesuit, which all had donned some time previously as a routine precaution, and said abstractedly, "Riggs testing. One, two, three, four. One, two, three, four." The droning voices of the other nine rattled in his headset as the rest of the crew followed suit.

Now less than a hundred kilometers from the smooth and barren surface of their objective, Riggs threw over the landing rocket switch, cutting in the hydrocarbon steering rockets for the landing. "O. K., Price," he snapped, his voice hollow and strange inside his helmet.

The computer immediately clipped out three figures, designating their position relative to their objective.

The system used for navigating spaceships to a landing had been developed many years previously, and had not undergone substantial change as most other techniques improved, since it was a model of simplicity, considering the difficulty of the problem to be solved. All bodies which were ever visited were given an arbitrary north and south pole by the Patrol, determined by comparison of the inclination of the planet's axis to the plane of the ecliptic of the Solar System. With north determined, three co-ordinates could describe the location of a spaceship relative to any point on a planet's surface, the three points being, respectively, distance north—or south—of the objective, distance east—or west—of the objective, and finally altitude over the objective.

Motions automatic from long and constant practice, Riggs soon had the *Little Falls* directly over the landing base next to the observatory, lowering the ship vertically in the simplest kind of a landing. Price's voice barked three figures into Riggs' headset every few seconds, but now two of them were always zeros as Riggs kept the ship directly over the field, indicating that there was no north-south or east-west displacement. As they came within hundreds of meters of the surface, velocity almost killed, Riggs laid the ship over on its side and lowered it smoothly on flaring steering rockets, grounding it with scarcely a jar.

The crew carefully snapped off their safety belts and dropped to the lower wall of the control room, looking out the ports.

Hawley glanced at the gauge before he left the board. "You used almost all the fuel allowed for a point six G landing, Riggs," he noted.

The copilot nodded. "Yes, sir, no sense cutting the first one too fine. Landing is no time to make a mistake."

Hawley smiled archly. "Wise words, captain," he drawled.

Riggs kept his eyes averted to conceal his ire, mentally kicking himself for the slip. Conklin's words that Hawley was a good man to work under on patrol rang mockingly in his ears. He was thankful that the routine of servicing the observatory kept them apart for the next few minutes, until he had time to cool down.

HAWLEY remained within the ship as Riggs led Clark, the astronomer, and Cutler, one of the engineers, to the observatory dome. Cutler dragged a small dolly behind him, laden with rolls of unexposed film. The low gravity of the planet made movement easy despite their bulky spacesuits. Riggs led the way to the lock in the side of the dome, and in a few moments had it open. The other two followed him through the low doorway. Inside the radium lamps were

coming to a slow glow, heating up as the automatic relay connected with the lock turned them on. In the growing light Clark stepped over to the moderately sized refractor, checking on its lubrication reservoirs, on the condition of the many motors connected with the clockwork. While Riggs checked the observatory clock against the *Little Falls* chronometer, Clark and Cutler quickly removed the film magazines from the delicate cameras, and substituted others of exposed film. One last bit of work removed the rolls of graph paper from the cosmic-ray detectors, and the men were returning to the ship.

As they stepped back to the air lock of the *Little Falls,* a crew under Hawley was just completing the job of filling the fuel tanks of the observatory with the chemically pure water that served as fuel for the atomic motors that powered the whole plant. Scarcely an hour after they had landed, the spaceship raised its nose to the heavens, jets blasting the frozen ground, and rocketed off into space, headed for a far-off sun.

Riggs sat for some minutes beside the commander at the control board, watching him correct their course as Mercer read off the co-ordinates in Price's place. At last the older man leaned back. "Ah," he breathed, "that ought to get us there."

Riggs nodded silently, not trusting his clumsy tongue to keep off tender ground.

"Say," Hawley wanted to know, "did you adjust the clocks in there?"

"No, sir," Riggs replied. "They were only two-tenths of a second off, and I didn't think that was enough to bother with. I'd as like as not have introduced a larger error in the other direction."

Hawley agreed in silence, then turned to the other two in the control room. "I suppose the boys down below would like a little help developing and printing that film," he said. "What do you say, do we give them a hand?"

The other three stood up and began divesting their suits as they prepared to follow their commander to the photographic laboratory three decks below, leaving the *Little Falls* to find her prosaic way through the emptiness of interstellar space.

DAYS ran into days as the *Little Falls* alternately accelerated and decelerated as she visited planet after planet. The time-consuming routine of gathering and replenishing film, of developing and inspecting it left little time for personal contact between Hawley and Riggs. The copilot, ever conscious of his secret mission, made every effort to keep his relations with his superior as impersonal as possible, always fearing an open rupture between them. He was forced to admit, however, that Hawley was apparently all that a pilot should be. After the first landing, which he had wished off on Riggs, the commander alternated on landings with his copilot, making smooth, sound approaches under varying conditions of gravity and atmospheric pressure, never showing the slightest hesitation or confusion.

Riggs secretly permitted himself to wonder, however, just how Hawley would fare should he have to land the ship from any position other than the vertical. The commander had made no "fancy" approaches, always carefully bringing the *Little Falls* directly over their objective before letting down. Riggs, as a matter of policy, had not attempted any angle approaches, afraid that Hawley would look upon them as a personal challenge, and even more afraid of his subtly scornful remarks, so delicately concealed beneath routine conversation.

Fifteen of the scheduled thirty stops of the *Little Falls* had been completed before the event for which Riggs had been waiting occurred. The planetary system of Rigel II was one of extreme interest to terrestrial astronomers, since it was one of the few which did not con-

form to the usual arrangement of having all the planets in approximately the same plane. The sun's nine planets revolved around it in nine different planes, and even the various moons did not conform to any general plan. This arrangement of planetary bodies, incompatible as it was with the general theory of origin of planetary systems, naturally excited interest, and observatories were located on several of the bodies in the system.

Besides its astronomical interest the system of Rigel II commanded close observation because its first planet, a huge, deeply atmosphered body of enormous surface temperatures and pressures, manifested evidences of high-temperature life. The physical conditions of its surface made it inaccessible to men, so that a compromise observatory had been erected on its only moon, a body that always faced its parent. This moon, like its planet, was often obscured with clouds, and in just such a time of precipitation Hawley approached it for a landing.

The navigator and computer were unable to get adequate observations on the observatory, with the result that Hawley was forced at the last moment to change his course and attempt an angle approach. Riggs tensed himself as Mercer finally located the observatory, well off to one side—too far to permit a vertical descent.

To the copilot's surprise, Hawley did not ask the computer for an equation to express the optimum course of the *Little Falls* through the moon's atmosphere to the ground. Instead he sat silently at the controls, listening to the co-ordinates Mercer snapped out from instant to instant. Riggs' mind flew as he tried to work out the equation in his head, as Hawley was undoubtedly doing—the equation which would describe the parabolic curve that they were following through the murk. He marveled at the major's confidence in his mental computations, descending as he was, to an objective that was completely shrouded in mists. He felt the ship lay over on its side and waited tensely for the crash as it grounded. But Hawley dropped it to the muddy surface with scarcely a jar. In spite of himself, Riggs could not repress an ejaculation of relief and amazement at the landing.

He regretted it in an instant as Hawley shot him a twinkling glance, a glance that made his "Not bad for an old man, eh, Riggs?" completely redundant.

"No, sir," Riggs replied obediently, glad to see the commander lead a small crew out to get the graphs and photographic magazines from the observatory.

Riggs seethed inwardly at Hawley's all-too-apparent condescension, wishing fitfully that he could talk to somebody about it. The old dope, proud of his mental calculation, was he? Thought he was pretty good to hear a computer snap out three co-ordinates every five seconds and to transform them into a fourth-power parabolic equation. Well, there was more than one man in the world who could do it, Riggs reflected. He had kept abreast of Hawley's mental mathematics. If he hadn't known they were making the grade, he would have taken those controls away, major or no major. He stopped his annoyed reflections as Hawley stepped out of the air lock.

"Let's go, Riggs," Hawley snapped, grinning a little.

RIGGS climbed silently into his seat behind the board, pressed the take-off warning, and as soon as the others were strapped in, blasted the *Little Falls* savagely off the surface.

Hawley seemed more disposed to talk than previously as they sped toward the second planet of the same sun. Feeling his oats, Riggs reflected, proud of that landing.

"Well, there's one thing about that last place, Riggs," Hawley observed, "it had enough of an atmosphere to look a

little like Earth." He swung a leg nonchalantly over the arm of his seat.

"Yes, sir," Riggs got out, "but I've never seen quite so vicious a cloudburst as the one we landed in."

Hawley laughed. "That's one of the places where a live observer would go mad in three months, right?"

"You bet," Riggs replied, drawn into conversation in spite of himself. "Makes you feel kind of queer, do you know it," he went on, "to go from planet to planet, and never see a sign of intelligent life? Why, take a look at this system here. At least four of these nine planets could be inhabited, especially if the settlers were willing to do a little selective breeding. They all have oxygen atmospheres, their gravities are close to Earth's, and temperatures and pressure aren't impossible at all. You'd think they'd be inhabited."

Hawley shook his head. "There's too much prejudice against it. They'll have to develop a new race. Those planets won't be colonized from Earth, but as soon as the few colonies that are in existence now get going, they'll start colonizing all over the Galaxy. They'll have a heritage of pioneering behind them, not so much attachment to the place they live in. That's what's the matter with Earth. Population groups stagnated for so many thousands of years that the attractions of staying home are too great. You really can't blame them."

Although Riggs was pleased to find that his superior could act and talk like an ordinary human being if given chance enough, he retained his resolve to at least equal Hawley's approach on the next landing he shot. Accordingly he approached the second planet of Rigel II at a sharp angle to the surface, and, like Hawley, requesting no predetermined equations from the computer, quickly set up a parabolic equation of the fifth power of the potential series to describe the course of the spaceship, and began the necessary mental substitutions and subtractions as he tried to determine how far the *Little Falls* was departing from the course he had set up. Almost subconsciously he could hear Mercer working his calculator, while Price called out the co-ordinates. That meant that Mercer didn't trust him, that the navigator was substituting the co-ordinates that the *Little Falls* was cutting in an effort to determine whether Riggs was conforming to any general equation.

In spite of the apparent doubts of the navigator, Riggs successfully landed the *Little Falls* without further aid from either the navigator or the computer than the co-ordinates that Price called.

Hawley made absolutely no comment on the landing. The rather pointed silence of the computer and navigator, who both were well aware that the two pilots had performed remarkable feats of mental calculation under extreme pressure, made it clear that all four in the control room realized that Riggs had accepted Hawley's challenge. They realized Riggs was willing to match any feats of piloting the older man performed.

THE copilot was not to be disappointed. Shooting the next landing, on planet three of Rigel II, Hawley performed the almost impossible feat of using only one steering jet until he laid the ship over on her side for the grounding.

The strain, while hard on the two pilots, was worse on the computer and navigator. After a particularly spectacular exhibition of a spiral approach at high velocity by Hawley on planet seven of Rigel II, Mercer approached Riggs while Hawley was leading the service crew to the observatory.

"Pardon me, captain," he said, saluting. "Perhaps I'm speaking out of turn, but this contest between you and Hawley is getting pretty extreme." He

stopped and gulped, half expecting a severe reprimand. Riggs grimaced for a moment before he answered the navigator.

"You're right, Mercer," he finally said. "Hawley undoubtedly can do anything any pilot in the Patrol can. I don't think he's run out of tricks yet. I suppose I could match that one of mentally calculating a three-dimensional curve to a blind spot, but I'd like to do it alone, instead of with nine other guys behind me. I think I'll call the whole thing off at the next landing."

"Yes, sir," Mercer murmured. "I hope you don't think I've been impertinent, sir," he half asked.

"Oh, no, Mercer," the copilot answered. "Hell, I don't see how you guys have stood it this long. It's damned lucky that the boys in the back end didn't know what was going on. Some of them who don't have space ratings would have gone nuts."

"That's just it, captain," Mercer said, a little smile forming in the corners of his mouth. "Price let on that you two were having a sort of contest, and Clark has gone half insane every time one or the other of you tried something harder. It wouldn't have been so bad if you were just filling in co-ordinates on some curve equation I'd figured out for you, but this stuff of forming your own equation as you landed had them all scared. I don't think I would have spoken if the men below hadn't asked me to."

Riggs began to chuckle. "I thought there was something a little screwy about this, Mercer," he laughed. "You've been around too long to mind a little thing like this race we had. Well, you can pass on the word that it's all over. I don't want Hawley to know, though."

"Oh, sure, captain," Mercer grinned. "I get it, all right."

APPROACHING the ninth and last planet of Rigel II, Riggs brought the *Little Falls* in at a sharp angle, as each man had done on the several previous occasions. He could see Hawley watching him with intense interest, trying to determine what kind of a three-dimensional curve Riggs would try to ride down. But the copilot held the *Little Falls* off until he was over the objective, and then lowered straight down, keeping his eyes fixed dead ahead on the visiplate to keep from seeing Hawley's superior smile. The damned show-off, Riggs thought—grandstander. He thinks he's done something. At least I've got enough sense to quit before one of us kills the whole crew.

In spite of his determination not to show his feelings, Riggs all but exploded when the relieved Price offered comment on the landing, the first given since the contest had begun.

"Sweet, captain," Price said.

Hawley seemed suddenly to choke, and coughed heavily several times, while Riggs knew his neck was turning a gaudy shade of purple.

"Thanks," the copilot finally croaked to the embarrassed Price, who knew he had put his foot in it.

Hawley, realizing that Riggs had quit, made no more fancy approaches on the next several landings. The routine of visiting various suns went on. But a series of events, culminating in the landing on the tiny fifth planet of Bruno in Aquarius, disturbed Riggs greatly.

The commander had not been his usual lofty, sarcastic self during his previous watch. All of the other three in the control room had been the objects of wrathful flare-ups, over trivial occurrences. As the time for the landing on the little planet came closer, his nervousness and tenseness seemed to increase, and by the time the *Little Falls* was dropping toward the surface in its approach, his disposition had grown so short that he had practically ceased to speak to the others.

Shooting the landing in his regular

turn, Hawley's approach was entirely conventional, dropping straight down from over his objective. But as the *Little Falls* lowered on drumming rockets, the ship swung from line, and the long succession of zeros with which Price had prefixed his altitude figures rapidly became numbers indicating that Hawley had badly botched the approach. Instead of altering his approach into a sharp angle, and repeating his performances on the planets of Rigel II, the commander blasted the *Little Falls* back to altitude and started his approach once more, only to become badly confused again. This time he attempted to save the landing by converting it into an angle approach, but the tense Riggs, following the co-ordinates that Price was barking out, quickly realized that Hawley was still messing the landing.

The commander shook his head savagely and swore. He took his hands from the controls and snarled, "Take over!" to Riggs, who elected to blast back to altitude and try a straight approach to straightening out Hawley's extremely incorrect position.

The silence that reigned in the control room after Riggs grounded the ship made those that had regularly occurred during the landings of the planets of Rigel II seem trifling. All four carefully kept their eyes averted to prevent what each knew would be the exchange of a knowing glance. Hawley made matters no easier by remaining in a surly and disgruntled mood, obviously disturbed over his clumsy mistake.

The next landing was, by the tacit arrangement to alternate approaches, Riggs'. He found himself hoping that he would mess it slightly, and in spite of himself dropped the *Little Falls* a little heavily to the ground. Hawley did not seem cheered by this, but rather insulted. He said nothing, however, merely speared his unhappy copilot with a venomous eye.

Contrary to what Riggs had expected, Hawley's next approach was excellent, in spite of the fact that it was made under extremely unfavorable conditions of gravity and visibility. He had half expected Hawley to become confused again, remembering how easy it was to lose that keen edge of self-confidence and instantaneous, doubt-free response necessary to land a spaceship on her rockets. The commander, while rather sullen, grounded the ship perfectly, and repeated the performance three times thereafter in his turn.

The copilot found himself worrying long before they headed back for Earth, what he would report to the board of examiners. One bad landing was usually enough to cause at least a complete examination of the case, Riggs knew, even in the case of young pilots, and in Hawley's instance, he felt sure, any report of loss of confidence might suffice to cost the aging pilot his space rating.

THE BAD approach had quite completely broken down what camaraderie had grown up between the two pilots, and Hawley rarely spoke to Riggs outside the line of duty. Shortly before they headed back for Earth, however, the two were together in the projection room, eyes riveted to the screen as a roll of film exposed at the observatory last visited was run through the projector.

The two sat in silence as the screen indicated the fixed positions of the stars in space and the irregular zigzagging of the three planets of the same sun as caught by the robot eye of the telescope. Suddenly a tiny point of light appeared where none had been before, instantly noted by both men, trained observers as they were.

"Nova," they said in quick unison.

Riggs cut the motor, and backed the film up, running it through one frame at a time. "There it is," he said. "First photographically detectable one hundred and four days after that observatory was

serviced." He started the projector again and the two watched the image of the nova grow rapidly, then fade with astounding suddenness.

"Umph," Hawley grunted. "That was a quicky. How long did it last?"

Riggs was reading the date on the frame. "Four hundred and twenty terrestrial days between appearance and disappearance, photographically, but it was really quicker than that. It had sunk to the twentieth magnitude in two hundred days, more or less. Sort of looks like Hunter's hypothesis might be correct, doesn't it?"

Hawley shook his head slowly as the rest of the reel ran through the projector without event. "I don't know. I'm not up on nova theory. I stick fairly close to home, with this navigational theory. That's my chief interest." He switched on the lights in the tiny projection room. "I suppose I'll be teaching twelve months in the year pretty soon," he observed, not looking at Riggs.

The copilot jumped a little. That was dangerous talk. He said nothing, playing safe.

"What d'ya think about that?" Hawley demanded, his black eyes snapping at Riggs.

"Why, I don't know, sir," he replied. "If you like teaching that well, I'm sure it's the thing to do."

"Don't play dumb, Riggs," Hawley snapped. "You know what I'm talking about. They may take my space rating away."

Again the copilot kept a reserved silence.

"Well," the commander demanded, "don't you think they will?"

Riggs shook his head and swallowed before answering. "I couldn't say, sir. I thought that was all up to the examiner. I see no reason—" he started to say, then cut it off.

Hawley smiled nastily at him. "You aren't kidding me, Riggs," he said. "I know you're the examiner here. What you report will decide what the board of examiners does. Isn't that right?"

Riggs said nothing.

"Oh, all right, I know you can't say anything, but you don't fool me a minute. Conklin is about as subtle as a crutch. He picked you because I gave you the highest marks in theory. That doddering old walrus." He laughed a little bitterly. "Well, I suppose it had to come sometime. I had visions of keeping that rating till I was forty. I'd only have to pass four more," he said, almost pleading.

Riggs still made no comment, packing the film into its cans.

"I can't understand what went wrong with that landing," the older man said. "I must have been thinking about something else. After all, I never had a bit of trouble with all those angle shots on Rigel II." He looked inquiringly at Riggs, but the copilot gave him no encouragement.

"All right, all right," Hawley said wearily, "be a good little soldier." He walked to the door, leaving Riggs standing by the projector. "But don't you try to kid me," Hawley said, hand on the knob. "I know you've been laying for me ever since we started this patrol. You're still hot about the way I treated you in class, aren't you? Sure you are, you ungrateful pup!" He yanked the door open and stepped through it before Riggs could deny the accusation.

Riggs stood beside the projector, automatically disconnecting the leads, half glad that he hadn't had a chance to deny Hawley's charge of carrying a grudge. He wasn't quite sure that it wasn't true, after all. He still didn't know what he should do about his report as examiner. Hawley had undoubtedly badly botched a landing. He had become confused, what was worse, and given up. But on the other side was the fact that he had successfully

completed several extremely difficult approaches prior to his poor one, and made several good routine landings after it. It *was* a problem.

BACK an Earth, with the *Little Falls* patrol completed without further incident, or further conversation with Hawley, Riggs had two days before the meeting of the board of examiners to complete his report. He went before the board, finally, with very mixed emotions, and very uncertain of his decision.

The three members of the tribunal sat in solemn dignity at a long table at one end of the chamber. Hawley had arrived before Riggs, and he showed no surprise when his copilot entered. Riggs tried to compose himself, mentally dreading the moment he would have to stand up, now a mere second lieutenant, and hold typewritten sheets of paper in his hand as he read his report. He cursed his trembling fingers, knowing they would reveal themselves in the fluttering of his papers as he tried to read.

Major General Conklin, officiating for the board, cleared his throat and rumbled, "Lieutenant Riggs, please take the floor."

Riggs stood up, leaning against the edge of the table to conceal his shaking knees. "Yes, sir," he said, trying to mask the quaver in his voice. Out of the corner of his eye he could see Major Hawley's superior smile.

Commander Conklin growled again, "As examiner aboard the *Little Falls,* will you please give your report on any members of the crew who were up for their space ratings?"

Riggs saluted wordlessly, and steeled himself to begin. "Besides myself there was only one other pilot aboard the *Little Falls,* sir," he said, "and that was Major Hawley. Major Hawley demonstrated to my satisfaction his complete understanding of all the details of piloting a rocketship and his excellent theoretical knowledge of the piloting of the same."

He could hear a sigh of expelled breaths as every man present noted his slight emphasis of the word theoretical. Dictaphones hummed softly as his words were recorded.

"However," Riggs continued, "Major Hawley, in spite of performing what amounted to feats of piloting ability, became badly confused on one landing, so confused, in fact, that he turned the controls over to me. Subsequently he landed five times perfectly. Gentlemen," he said, "I am unable to account for Major Hawley's sudden lapse. Considerations of his advanced age, as far as piloting goes, make it seem likely that he might be expected to experience difficulty, progressively more difficulty as he gets older. However, his ability to handle the ship with no apparent effort on all other occasions, and the fact that he did not seem to lose confidence in himself after his unsuccessful approach, seem to indicate further examination by this board.

"I feel morally certain that Major Hawley's lapse was due to some temporary physiological difficulty which passed unnoticed by him and which is either very unlikely to recur, or can be simply corrected. Therefore, instead of recommending that Major Hawley show cause why he should not be deprived of his rating, as might seem indicated, I recommend that he be given a complete physical and psychological examination by the board, and that if nothing is found wrong, his rating be extended another year."

RIGGS sat down, feeling a little better about his report. It had gone off rather well, he thought, and he was sure he was right. Hawley wasn't through yet. Maybe next year, or the year after, but not this year.

Commander Conklin made no com-

ment on Riggs' report other than to send an orderly to pick up the typed sheets. He "harrumphed" again and slowly said, "Major Hawley, your report, please."

This was a complete surprise to Riggs. He had expected at the most that Hawley would be given a chance to defend himself against any detrimental evidence presented by Riggs, but a report from his former commander was unexpected.

The small man stood up, very straight and martial in appearance, his black eyes snapping, his face otherwise expressionless. "I report that the board's original presentiments with regard to Lieutenant Riggs were completely justified. Besides showing great native ability as a pilot, he has shown great tact in handling a delicate situation, and a levelheadedness that compels me to recommend him for the promotion you gentlemen had in mind." He sat down, likewise not giving his erstwhile companion a glance.

Riggs, overjoyed at Hawley's report, felt that his cup was running over. He expected Conklin to mumble an acceptance of the reports, but to his great surprise the commander suddenly called his name again. Riggs stood up.

"In view of certain extenuating circumstances known to the board," Conklin began, almost self-consciously, "we find it necessary to reject your report in the form it now stands. Major Hawley is hereby certified for a space rating for one year without further examination. Meeting adjourned."

Bo Riggs got stiffly to his feet, the bottom of his stomach apparently somewhere near his knees as he struggled to walk out with an unconcerned air. Hawley got up, too, and walked out at his side.

As they reached the corridor, but before the examiners had begun to file out, Hawley tapped his junior on the shoulder. "Look here, Riggs," he said, smiling a genuine smile at last. "You've got most of the makings of a good officer. There's only one thing you'll have to combat."

"Yes, sir," Riggs said wretchedly, knowing nothing else to say in his confusion.

"Yes, sir," mimicked Hawley. "The trouble with you, Riggs," he went on, "is that you're too damned naïve. I'm almost insulted to think that you believed I really botched that landing that badly. Don't you know a put-up job when you see one?"

He grinned evilly and walked away, while the incipient Captain Riggs alternately knifed him mentally in the back and blessed the day he was born.

A QUESTION OF SALVAGE

By MALCOLM JAMESON

A QUESTION OF SALVAGE

The salvage fleets had no place for a man with a conscience—but sometimes one showed up, and sometimes they left "junk" behind, when the ether storms were strong—

By Malcolm Jameson

Illustrated by Schneeman

I.

SAM TRUMAN, mate and acting captain of the *Kwasind,* leaned back against the guard rail of the two-hundred-foot stage of the firing rack which cradled the ugly sphere of his powerful salvage tug. He was staring moodily at two of his black gang, clinging like flies to a pair of bulbous towing bitts sticking out of the hull above him. They had finished burnishing the rugged knobs and were now testing the connections of their heater units. Lower down, two monstrous electric cables led into the tug, through which the squat storm craft was sucking the huge stores of reserve energy she would be needing any moment. From beneath, far down where the nadirward nozzle of the main rocket tube threatened the seared and pitted slag of the dockyard, wisps of acrid smoke trailed. The tube was hot, white-hot. On ten seconds' notice the *Kwasind* could soar into the void.

The *shoosh* of nearby spacecraft caused him to wheel. Ah, a hygiocopter. And another, and another—three of the red-banded ambulances of the ether taking off. There must be trouble in the space lanes already. Then, out of the clear Martian sky he saw the halting descent of a shiny superliner, saw the raw flare of its check rockets mushrooming, watched it settle unevenly onto the public skyport a mile away. The outward bound hygiocopters checked their swift rise, wheeled like circling gulls, and came back to follow the crippled liner to the plain.

"Sizzlin' Syzygies!" came a voice from behind. "She's all stove in. Must be dusty out to crinkle a packet like the *Kop.*"

Dumpy little Ben Tiggleman, engineer of the *Kwasind,* had come out of the bowels of the salvage tug and was gazing open-mouthed at the newly landed *Copernicus.* A de luxe job like that, with a dozen of the top-hattedest bigwigs of the System and no knowing how valuable a cargo, did not turn back after ten hours out of port for small reasons.

But the two salvage men could guess the reason. Last night the stars had trembled and danced. Refraction bad, the "seeing" not good, they would have said centuries before, but nowadays men knew better. That was why the *Kwasind* and her five husky sisters were being warmed up, standing by. Sam Truman raised his binoculars and studied the grounded liner.

Her crumpled nose and those sagging plates between each pair of frames spelled but one thing—terrific pressure. She must have banged into an etheric typhoon and hit close to the eye of it. Nothing else could have flattened down

her screens and dished her in like that. And if the powerfully compensated "Pride of the Skies" had suffered so, it would be but a matter of hours until the ether would be flooded with S O S's. Inter-Planetary Salvage's tugs would all be out, combing the cosmic flotsam for prizes. The first vessel to slam a glimmering green hawser-beam on wreck or derelict walked away with half her value.

"Wonder why she didn't squawk?" queried Ben. "We coulda gone—hours ago."

"And have it go out over the Omnivox?" replied Sam with a hard laugh. "That would be bad for the passenger trade, scare off the cash customers. As far as landsmen go, this is still a hush-hush business. Weather in the void? Silly! You have to have an atmosphere for that. Remember what they taught you in school?"

A couple of IPS yard hands, loitering nearby, overheard and laughed.

"Well," said Ben Tiggleman, his gaze wistfully lingering on fifty millions of potential salvage, "I hope we snag a good one before it's over."

Sam Truman knew what was in his mind. Four hours earlier Mrs. Ben had been rushed to the maternity ward of Herapolis General Hospital, leaving a flock of little Bens behind her in the hovel they called home. Like most salvage men in minor jobs, Ben was always broke. Worse, he was in the clutches of a loan shark. But he shook his head and grinned and started to duck back into the whirring recesses of his engine compartment.

"How are my sky hooks coming along?" Truman called after him.

"Oh! Four are loaded and on ice; and one is on the fire, soaking up the ergs. Boy! You're sure packing power into those babies. I hope they work like you think, because it ain't going to be any fun if one of 'em backfires."

SAM TRUMAN watched his engineer go, then returned to his moody contemplation of the *Kwasind's* hull. She was ready to rise, all right, but he couldn't take any joy in the thought. It was too much like the soaring of a buzzard in search of fresh carrion. He remembered the last big storm too well —crushed and helpless ships swirling in the maelstrom of turbulent ether, while these tugs cruised comfortably among them, picking and choosing only those that promised fat salvage fees. "We are not in business for charity," was one of the mottoes of IPS. "Leave sentiment to the Space Guards—they get paid for it."

Another man in his job would have been atingle with what was before him. The work was exciting, and on occasion could be very, very profitable. Yet to his mind, there was something ghoulish about it. Now that he was familiar with the policies of the company, he hated the salvage business with all his soul. For the dozenth time he was on the verge of stalking into the manager's office and hurling his resignation into his fat, greedy face. Only, he reminded himself, today was not the day for it. He simply could not—it would look yellow. Moreover, it was futile. His quitting would not save a single one of the white-faced, praying passengers going to their doom because parsimonious ship owners refused to guarantee the minimum fee. A cargo of uranium ore was as good as cash in the salvager's hand, but what could you get out of two score rescued humans, with any assurance, but gratitude?

After this blow, perhaps, he would quit. Then— But that "then" was the tough part of it. That was the real deterrent. What could a man—a kick-out from the Space Guard and blacklisted by the Ecliptic Line—what could he dō next if he did?

If he chucked the job, there was nothing left—nothing. For to a young man

steeped in the traditions of skycraft, a planet-bound job was no job at all. It wasn't even living. He just couldn't think of life without the joy and lift that comes of plunging into space with the controls of a thousand thunders under the fingertips. What surface job offered the thrill of hand-jetting across ten miles of bucking emptiness to make fast a line to an inert wreck? What about the grim satisfaction of licking a "low" with a cumbersome tow behind, surging and tearing at the hawser beam? No, he told himself dismally, he would have to hang on. And like it. At least until he could make a killing and buy a ship of his own.

At that dream, he brightened. For the moment he was captain—only acting captain, to be sure, but still the captain. As such, he was entitled to one third the fee, not the lousy fraction of the ten percent that was flung to the crew to divide. If today he could swallow his scruples and do like the rest—pass up the unpromising jobs and concentrate on real loot—well! Next Settlement Day he could tell the whole gang what he thought of them and walk out. A pack of jackals, the lot of them. Ben Tiggleman, alone, seemed to have decent instincts.

HE WAS ROUSED out of his introspection by that worthy's sticking his tousled head out of the hatch and yelling.

"The dope's coming through now—have a look at your telescribe."

Sam quit the stage and made his way through the tortuous passages to the hemispherical control room in the heart of the great tug. He picked up the fallen tape and read:

"—series of etheric disturbances of great intensity following trough through asteroid belt, bearing eight four, absolute. Maximum 'low' located in third quadrant, not far from Mars, moving outward. It is described as an elongated ellipsoid of about five million miles along major axis and the gravitic equivalent at center is estimated to be of the order of several thousand megabars. Correspondingly strong 'highs' have been detected both above and below it as well as in front of and behind it, so that extraecliptic travel lanes are as impassable as the usual ones. Gravitic gradients throughout Mars-Jupiter sector at new record and zeta emanation abundant. Triple storm warnings authorized throughout this area.

"Communications with asteroids in that vicinity now completely disrupted. Fragmentary report from Juno at 0456 today, Systemic Standard Time, expressed fears for safety of residents on Juno and Pallas. Lighthouse tender *Cyclops* believed to have been dashed ashore on one of the posterior Trojans, where severe storm conditions also prevail—

"FLASH, Mars: Liner *Copernicus* limped back into Herapolis a few hours after taking off for Earth. Several of the crew severely compressed and many suffering from zeta burns. Some structural damage was suffered by the vessel owing to pounding by gravitic waves, but she returned to base without assistance.

"Special Bulletin for Space Guard and salvage vessels: The following is a partial list, as reported by their owners, of ships now en route through the storm zone: SS. *Stephen Clark*, out of Titan for Mars, 1000 tons rhodium, no passengers: SS. *Moon of Mars*, Herapolis to Callisto City, miscellaneous cargo, twelve passengers; SS. *Rattlesnake*, Io to—"

Sam's fingers skipped along the tape as he hurriedly examined the list. Ordinarily, the mercenary aspects of salvage had no appeal for him, but today—today was different. There was a chance to clean up. One good tow would do it, then he could duck the dirty job for all time. He would have his own ship. He could patent and market his

sky anchors. And he could put Ben, good old Ben, back on his feet, too. His share as captain would be ample for all those things.

So far, there were no distress notices that promised great reward, but that meant practically nothing. He knew from past experience that owners were slow to report treasure ships. They only gave up half when threatened with the loss of all; a worth-while bit of salvage had to be in a desperate spot before she would squeal. Those frantic appeals would come later. On a day like this, in the pounding, pulsating void above, great fortunes were sure to be lost—and gained.

There was a dull roar and a swish outside. That meant his neighbor in the firing rack had taken off; *Thor* was first out. Hardly had the *Kwasind's* floor plates quit rattling when a second boom was felt and heard—another tug had shot skyward. Sam glanced sharply at the annunciator on the bulkhead that relayed his orders from the dispatcher's office. It still glowed "Stand by." He smiled a grim smile as he understood. They were giving the regularly appointed captains the edge on him. It was common knowledge that most of them had an arrangement with the manager—they kicked back part of their fee. In fact, it had been suggested to him, if he wanted—

There were footsteps in the corridor from the hatch, and he heard the high-pitched, twittering voice of the half-breed Martian that acted as assistant manager. Sam Truman swung around to see what he brought. With him was a tall, heavy-set man in the uniform of a captain of the IPS. He was no captain that Sam had seen about, yet there was something vaguely familiar about him—that dark complexion, that air of half-concealed arrogance—

"This is Mr. Truman, your mate," the Martian was saying, "and he should be all set to go. But you had better keep an eye on him," and he chuckled shrilly, "he's an *altruist*. So take over, Captain Varms, and good luck."

"I've known Mr. Truman for many years," asserted the new captain with studied insolence, "and I know quite well how to handle him."

Eric Varms!

II.

"BLAST OUT! Mr. Mate," said Captain Varms, coolly impersonal. "I'll give further orders when we're outside." He stripped off his gloves and tossed them onto the chart rack, then began to study the meteorological instruments grouped on one of the indicator panels. He frowned importantly as he glanced knowingly from mesotron detector to argonometer. "Promises to be dirty weather upside," he coughed wisely.

Sullenly, his cheeks flushed with impotent anger, Sam Truman jabbed the key home that set off the warning howlers outside the hull. Tiny lights twinkled on the monitor as the gas-tight doors slid shut and locked themselves. Ben Tiggleman's "Ready" light glowed over the firing lever. Sam unlocked the main rocket release, clutched the safety grips, and shoved the lever home. With a shuddering rush the *Kwasind* launched herself at the zenith.

Sam clung there throughout the acceleration, his jaws clamped hard shut, boiling within. It was bad enough to be superseded in command at the very last moment—a typical IPS trick—but the crowning irony of it was to have to play second fiddle to Eric Varms. Eric Varms, whose astragation problems he had worked for him in the old academy days and whom he had taught the rudiments of skymanship. Eric Varms, his jinx—his Nemesis!

That was the same Varms who, while they were still both snotties, had squealed to the commandant to save his own skin and told where to find the bottle of forbidden Venusian "dragon

juice," saying that Sammie Truman had brought it into Lunar Barracks. His lips sealed by the midshipman code of honor, Sam refused to deny it. For that they bilged him, cut off his career in the Space Guard.

And it was Varms, five years ago when they were both senior mates in the Ecliptic Line and up for examination for the post of master, who had preceded him in putting the little trial ship *Elsie* through her paces. Eric had done all the stunts and come through all right. It was Sam's turn. "She's all yours," was what Eric said when he stepped out, "now go and bust yourself."

Prophetic words. Sam groaned to recall them. He was too cocky, too sure of himself that day—he should have inspected her. There *must* have been some dirty work there. No magnon circuit ever behaved like that one did, nor could the leads to the telltales on the monitor board have come disconnected by themselves.

That had been a ghastly crash. Not only was the trial ship wrecked beyond repair, but several bystanders were hurt, matters which cost the Ecliptic Line heavily. Sam himself spent the next several months in the hospital, too much in pain to know or care that a hostile Court of Inquiry was pawing through the fragments of the broken *Elsie* and listening to the insinuations of his rival for the vacant captaincy.

When he recovered sufficiently to face the browbeating spacedogs that made up the Court, they had already made up their minds. "Culpable negligence" was their verdict and the penalty was summary dismissal from the Line. Jobless and discredited, he had gone off to the outer planets in search of work only to lose berth after berth as his record caught up with him. So hounded, he could never accumulate money enough for a ship of his own—the only decent means left him to pursue the career he had chosen and loved.

In desperation he had turned to that last refuge of the disgraced spaceman—the salvage racket. Distasteful as some of its features were, when catastrophe struck there was opportunity; when the ether tied itself in knots the scavengers of the void found good hunting.

But now, just as the chance for liberation was in sight, Eric Varms' path had to cross his again. His ancient enemy was to be his captain and walk away with that fat share of the fee!

TO THE EYE there was nothing to indicate that an etheric storm of hurricane proportions was raging, but already they felt the beating surges of gravitic waves. The ship never wavered as she flung headlong into the void, nor was there thud or quiver. Men simply felt their weight come and go as a weirdly disturbing internal rhythm, indescribable to one who has never experienced it. It was not at all like the sickening feeling one gets when dropped suddenly, or the oppressiveness of being pitched upward, for the gravitic reference there is the Earth below. Here it was a man's own middle, his own bodily center of gravity. One moment he felt as if he would collapse internally from the weight of his outer flesh, the next as if about to fly apart.

Sam's hand lay on the compensator switch and he looked expectantly at his captain. Whatever Sam's personal estimate of him, the law of the sky gave him the exclusive right to command. Varms caught the query in the glance and sneered.

"If that jiggling worries you, go ahead and turn it on. I always did that in the liners. It kept the passengers from getting jittery."

Sam nearly choked, but he managed to swallow the retort. He knew now that he would have to go to the mat with this man, but the time was not yet. The tug must be made safe first.

He closed the compensator switch. He

had already noted the period of the vibrations and long practice told him their strength, so his tuning knob was already set. As new waves of gravitic force welled out of the ship's gravigens, matching the incoming waves trough to crest and neutralizing them out of existence, the uncomfortable coming and going of weight ceased.

Those first rhythmic impulses were no more than annoying to men used to them, and, of course, luxury liners had small compensators with which to damp them out—the little ripples that were often found in normal ether. But Eric Varms' allusion to it revealed that his superciliousness was as much due to sheer ignorance as to his characteristic maliciousness. Sam had been willing to smother his personal animosity toward the man for the duration of the storm, but rank incompetence might any moment ruin them all. In a typhoon like this one, when big liners were tossed about like leaves in a terrestrial autumn, waves of overwhelming force might strike them any instant. Then it would be, not a matter of comfort, but survival.

"LOOK HERE, VARMS," Sam Truman blurted out, determined to have the showdown at once.

"*Sir*, mister, when you address a superior," barked the new salvage captain, savagely.

Sam Truman glared back just as savagely.

"I never omit it," he said, coldly and evenly, "when I'm talkin to one. But that mess of gold sewed to your cap don't make you my superior, Eric Varms. In this game, and on a day like this, it's what you know that counts, and guts—"

"Y-you—" Varms strode toward him, fists clinched and scowling. Sam leaped away from the control panel and squared off, watching warily. If Varms wanted to do it this way, all right.

It was at that instant the big wave hit. That titanic surge of gravity froze them both where they stood, each glassy-eyed at the other, watching helplessly as their superficial muscles contracted like iron, squeezing the breath from both of them in one stinging gasp. Their too-ready fists smashed into their own sides under the impact of it, and the skins of their faces shrank until they grinned at one another like a pair of jocular death's heads.

It passed as swiftly as it came, and the instant its crushing grip relaxed, Sam's hand was at the controller, cutting in an additional gravigen. He turned to the shaken captain, still standing wobbly in the center of the control room where the gravitic blast had caught him. Sam balled his fist and held it up to Varms' view.

"We would be hard little carbon dolls, by now—just that big—if I hadn't had the first machine running. The counterthrust of that took most of the curse off it. No man living, or ship, could have stood up under that baby—a thousand megabars, if it was an ounce."

Eric Varms was dazedly exploring bruised ribs with fluttering hands. Ben Tiggleman eased into the room from the motor spaces, looking a little startled. Sam waved to him to be silent.

"Now Varms, as I started to say," Sam proceeded calmly, as if nothing had happened, "before this *Kwasind* and us in it is smashed to a briquette you could load on a truck, let's have an understanding. First off, we don't care a damn how you got your job. We can guess, but we'll skip it. You're the skipper—that's conceded. Under the mutiny laws we're hooked and we have to take it, even if you don't know what it's all about—"

Varms stiffened belligerently, and a hand stole toward his holster.

"Take it easy, Varms. Bluster won't buy you anything. That popgun of yours, considering what's going on

"Get up, you fool," snapped Truman. "That's zeta fire! Get your suit on before it cooks the flesh off your bones."

around us, don't mean a thing. I can yank this switch over a notch or so and you'll think that last little squeeze was a love hug.

"Now there's no use in your four-flushing any longer. Hard talk never made a salvage man yet. When you made that crack down in the dockyard about the weather, I had your number. This kind of weather don't register on instruments below an atmosphere. The only thing there that meant anything was the maculometer, and you didn't see that. Sunspots is one thing that's wrong up here. Anyhow, you couldn't know anything about weather in the Ecliptic Line; they ground their ships every time a Force-3 gardient is reported. All we want you to do is keep your trap shut and leave the heavy thinking to us.

"We're all of us in this thing for the living we get out of it, and mass suicide

don't come under the head of living. Somebody's got to have charge of this bucket that knows what to do. In the salvage racket you're not allowed even *one* mistake. The first one is *finish!*"

Captain Varms gulped and stared at his shoe. He knew his mate had him, and the engineer, silent, but with the suspicion of a grin on his face, was evidently against him, too.

"I'm open to suggestions," he said, craftily. After all, why not? If these birds wanted to do all the work, and the manager said they knew how, let them. He would get the lion's share of the money, anyway, and that was all he cared about. To hell with their opinion of him. And also he could watch and learn. There would be time enough later on to straighten 'em out.

SAM TRUMAN hesitated a moment before answering. It was no easy thing to explain a phenomenon that happened so infrequently and irregularly that even the scientists were baffled. It was only known that whenever solar magnetic radiation was unusually strong and there were also present exceptionally powerful cosmic rays, etheric disturbances resulted. It was believed that when the two sets of rays impinged at one critical angle, "highs" were developed, at another, "lows." Between the two a state of gravitic stress existed. Lately there had been an unusually fierce Nova in Scorpio, and sunspots were at the maximum for more than a century.

"We're going into a 'low' now," Sam began. "You can forget about the 'highs.' It's practically impossible to get into them, but if you did, like being grounded on a fairly heavy asteroid when one swept over you, you would get so light you might burst. Men, ships, rocks—everything has a tendency to fly apart. About all you have to remember about them is that they are the source of *positive* gravitic impulses. They fling 'em out. Gravitrons, they're called, and they come in waves—a pulsating radiation.

"A 'low' is a cat of another stripe. It is the complement of a 'high' and works on exactly contrary principles. In them, everything gets heavy—intrinsically heavy, if you know what I mean—about itself. And the sweep of the gravitrons tends to take you right to the center of the 'low'—blast as you will. Rockets are not much help if you get in far enough. And down in the middle are pressures you can't do anything about. It can suck in a fair-sized comet and squeeze it into an asteroid a mile or so in diameter. When a thing like that happens, the stress is relieved and the whole shebang dissipates. After that you have fine weather—until the next one.

"I don't know whether you ever broke away from the gin mills in Europa long enough to get into the museum there, but if you had, you would have seen the metallic lump there known as the 'False Asteroid.' It's an egg about twelve feet long and weighs close to ten thousand tons. That's what's left of the cruiser *Alcyon,* crew and all. They made a secondary X-ray analysis of it and have its components tabulated to the last gram. Alongside it is another table, computed from the plans and specifications of the *Alcyon,* including the stores aboard and the people in her—chemically described. The two tables are the same. That gives you an idea of the pressures at the heart of a 'low.'"

Sam paused. Varms, his brow knit in a scowl, moved restlessly, but did not interrupt. Sam went on:

"We can't go to the center of one, strong as we are, but we can go closer than anybody else. This crock is packed to the skin with reversible gravity generators, tractor-beam projectors and zeta-ray absorbers. No commercial ship has space for them, and

the Guard vessels have two thirds of it replaced by armament.

"Right now, all the ships and meteorites and cosmic gravel in this vicinity are swirling in big cubical spirals toward the eye of the nearest 'low.' If they get in too far, it's just too bad, but we can grab off some in the edges. Now and then one will be flung against an asteroid that's too big to move, and there they stick. They're salvage. First come, first served. The trick there lies in getting at them. There are bad gravitic eddies around a heavy planetoid and sometimes they will rebound right in your face.

"A lot of ships are still trying to fight their way out—rockets versus metagravity. If they think they can make it, they'll refuse a tow; if they know they're sunk, you've got a customer. You hook on, then, and pull them out—if you can.

"Once you have a heavy tow hanging on behind—and it's the heavy ones that pay—you have to pull double or worse, and that against a gravity that's likely to be as good as Jupiter's while it lasts. It don't help you a damn bit that it's a phony gravity, either. It acts like the real thing. I know it's purely local, too, but then, that happens to be the locality we work in. What if the strength of it does diminish with the seventh root of the distance, and not the square, as normal honest-to-God gravity does? You might as well say that ether, being a fiction and nonexistent, can't bat you around the way it does.

"And to make it perfectly tough, the closer in you get the worse the zeta rays are. Get out from behind a screen and watch your flesh begin to glow. It don't hurt—at first—and that's the bad part of it. But in a few minutes, if you're not crushed first, the meat drops off you, cooked and smoking. I'm not trying to scare you, I'm just telling you what you're up against.

"The point is that it's going to take all gadgets in this crock, *and those handled right,* to get us out of here with anything that's worth the fuel to tow her in. Bungle once, and we're done. You can see now what a hell of a crust you—"

"Ah, quite so," yawned Varms, elaborately. "A most entertaining and instructive lecture, I'm sure. Since you understand your duties so thoroughly, you may take over while I rest up for an emergency. Call me if you need me."

Sam glowered at the retreating back, then smiled contemptuously at the face-saving gesture. His outburst had had the effect he desired, but there was little of the satisfaction of victory. He and Ben still had to do the work of this parasite and be content with the little end of the reward. But salvage was hard enough on body and conscience without the complications of incompetent meddling. To the extent he had forestalled that, he was satisfied.

Chubby Ben Tiggleman delivered a solemn wink of approval. Their previous captain had been much of the same type.

III.

A SMALL GONG tapped three times. An object nearby, something with real gravity, not the immaterial, cosmic ray generated pseudogravity that made up the etheric weather waves. Sam clicked on the periscope elements of the side toward it and brought its image onto the visiplate. It was a small ship, about ten miles to port, bucking heavily, as if tossed by enormous walls of palpable fluid. From her tail a narrowing streak of brilliance stabbed, only to be pinched surprisingly to a sharp point a few miles astern of her.

The brilliance of the exhaust bore witness to the recklessness with which her master was squandering fuel. Its constriction from the ordinary flare of rocket exhaust was eloquent of the all-pervading tendency to self-compression.

Pressure everywhere were high by then, even the troughs of the waves must be higher than normal Earth pull.

"She's making pretty heavy weather of it, isn't she?" said Ben, looking over Sam's shoulder. "Little tramp, I guess, with enough low-grade ore to pay the overhead and a handful of passengers for profit. Probably a group of school-teachers getting an eyeful of the wonders of the Universe on their summer vacation, or some retired farmers having their fling."

"They'll be flung, all right," said Sam grimly. That was the kind of distress that took the joy out of salvage work. The ship was obviously a waif of the spaceways, probably mortgaged to her dome plate, while her passengers, if any, were nobodies—small fry that had scraped their last bit of money together to pay for one grand outing. He knew from the lack of Line markings that she was no fit prospect for IPS.

Just then the thin flaming line of its wake darkened to a streak of black—then vanished. With the practiced eye of the born skyman, Sam photographed on his memory the pattern of the stars beyond her. There was a bright one close to her stern and a pair of others just forward of the bow. Presently the bright one astern was occulted by the storm-tossed craft and the interval to the forward pair widened. The struggling ship, which had been doing hardly more than hold its own against the grasping lines of force, was making sternboard. In a short while, she would be plunging unrestrained into the maelstrom of the enveloping "low."

Her S O S came in startlingly clear. Sam noted her visicode number and focused his radiophone so he could speak with her captain. In a second he was looking at a cloudy picture of an old-fashioned control room, cluttered with obsolete instruments. Facing him was an elderly man, staring with haggard eyes from beneath a cap that showed his rank but not the device of any rated line. Behind him stood a vague huddle of people, probably gathered in the control room to take advantage of the one small compensator such liners usually carried. Sam thought there was a woman or so among them, but his reception was so bad he could not be sure.

"*Berenice* out of Io for Earth, Captain Tribble speaking. After fuel bins empty. I need four hours to break out reserve supply from the nether bunkers and preheat it. Can you hold me up that long?"

"Who pays the bill?" asked Truman reluctantly.

A look of despair crossed the anxious captain's face .

"You can have my equity in the ship," he said heavily. "It's all I have. There are eight hundred tons of tribonite on board, and five passengers. I daresay they might raise a little money. Of course I know tribonite isn't—"

His words trailed away. He knew he was asking the impossible. Inter-Planetary's reputation was firmly established. Cash on the barrel head was the rule—that is, salable stuff in sight—or an ironclad guarantee.

"Heat up your contracathode, I'm coming alongside."

Sam Truman surprised even himself as he snapped out the decision. It must have been the expression of all the long-smoldering rebellion in him; his detestation of the porky manager back at Herapolis, his contempt for the sleeping Eric Varms, his hatred for the policies of the IPS and his loathing for the part he himself had so often been compelled to play. All of that welled up within him for force that reckless gesture. They could pay no adequate fee, of course. Sam knew that. IPS would fire him. Then it occurred to him that they would probably also fire their newly hired skipper, Varms. He should have been on the job, not asleep. Sam

smiled grimly at that thought—a captain can't pass the buck.

THE SQUAT, ugly sphere came slowly up in the dead wake of the *Berenice*. Ben Tiggleman was at the hawse-beam controls, hand on switch. The towing bitts of the *Kwasind*, a pair of mushroom-shaped cathodes, were already white-hot, so that they could hold and maintain the tricky electronic beam. As the tug drew abreast of the plunging *Berenice*, Sam Truman noticed her primitive contracathodes still dull and colorless. Savagely he snapped the communications switch.

"Bear a hand with the heat," he yelled. "I can't hook onto you like that."

The captain of the *Berenice* showed his worried face.

"All my auxiliaries are dead except the compensator—"

"Then send a couple of men out with torches!"

"No zeta shields either. They'd burn up before they started. Can't you hold me with a magnetic grapnel?"

Sam swore heartily. It was true that the *Berenice* was bathed in the faint rose luminescence of zeta fire, but a magnetic grapnel! As well use a rope of sand. He wanted to help these people, but their captain seemed to lack resourcefulness.

"They want it fed to them with a spoon," observed Ben, dryly, but Sam was climbing into a spacesuit.

"I won't take a boat for this, close aboard as she is. I'll heat their damn bitts for 'em, by hand. The minute I give the sign, slap the hawser down; then haul short and wait for me. As soon as I'm back in the lock, give her the gun. Gravity's running heavier here than I thought."

He was halfway to the wallowing *Berenice* when a heavy gust sent him flying far past her stern. Under the impact of it his bones ached as after the blast of a heavy gun. The little compensator in his suit was not nearly so adequate as the one in the tug, but after that first mighty wallop he found himself still alive, although it was difficult to breathe. He supposed that the proximity of the two vessels, each possessing real gravity, had caused the pseudogravitic waves to bunch between them.

His hand rocket was blazing fiercely and it was easy to check his headlong fall away from the two ships, but when he tried to fight his way back he found he was gaining nothing on them. He snapped on his torch to add its reaction to the other, but the additional forward progress was negligible. An occasional extra heavy surge would catch him and throw him back as far as he had come. Ben, he knew, must be watching him, and if need be would drop down in the *Kwasind* and pick him up. But that would be wasteful of time and would require a new approach to the helpless excursion ship.

A daring thought popped into his head. A plain bitt, hot enough, would hold a hawser-beam, so would his helmet. He turned his torch against it, hoping fervently its insulation was efficient enough to prevent him from cooking his brains. Feeling no more than moderate discomfort, he continued cautiously until he could bear it no more. He doubted if the peak of it was more than a dull red, but it was worth a try. He sang out to Ben to throw him a small line.

He clamped his jaw and let the sweat roll. The experiment wouldn't take but an instant. If the line refused to catch, he would have to try something else. He watched feverishly the snaky, lashing thread of green fire that was flung at him from the fat sphere ahead. Five times it whipped about him before it found its mark. Then, with a jerk that nearly decapitated him, it snapped

taut. He was yanked ahead violently, induced currents of electricity thrilled through him, galvanizing his limbs into jerky grotesqueries that were agonizingly painful. In the kaleidoscope of wild sensations he was experiencing, the nightmare conception that he was being hanged and electrocuted simultaneously stood out as his most salient agony.

By the time he had gained a little command of the whirling sensations that almost maddened him, he perceived that the *Kwasind* must have pulled ahead, for he was dangling at the end of the fiery fiber just over the nose of the hapless *Berenice*. Ben evidently cut the switch —the green thread of light faded into an attenuated puff of smoke and Sam was slammed hard against the bow of the drifting ship. He flung an arm around the cold, hard bitt and drew himself up to a squatting position beside it.

The faint rosy aura was all about the hull he knelt on, and the rigid hairs of brush discharge stood abundantly on top of the bitts, but he disregarded them. His suit was reasonably proof against them and he had not yet felt the ominous tingle that would indicate a leak. He applied his torch to the bitts and little by little they warmed—dull red through cherry to a pale straw. He yelled into the mike and jumped clear. Having just suffered the shock from the thin thread of his own little towline, he had no desire to be struck by the heavier hawser.

The writhing serpent of maddened electrons again lashed at him, a fatter spark and far more deadly, but he was well clear as it groped the nose of the *Berenice* in its hunt for the one excited spot that would hold it. Then it caught the bitts and clung. The *Kwasind* hauled it taut and quivering, then slowly backed down along it as a spider on her web. Seeing his work done, Sam plunged into space, jet and torch both burning, and breasted his way yard by yard to the open lock in the underside of his tug.

BEN TIGGLEMAN was too old a tug hand to be much impressed by the bit of unique lassoing Truman had just done, but as he examined the heat-blistered helmet of the suit Sam had taken off, he did ask:

"How was it?"

"Terrible!" grinned Sam, ruefully rubbing his neck. Stiff with electric cramps, he poured himself a beaker of water and downed it, grimacing.

"Give her the works," he added. "In a few hours that old galoot back there ought to be able to carry on by himself. We can cast him off, and if friend Varms is still snoozing, we will have done our good deed for the day and won't have to catch hell for it."

"She's three bells and a jingle already," said Ben. "The old girl won't do any more."

Sam hobbled to the periscope and had a look at his tow. She was rearing and yawing, laternately riding ahead on the shiny green line or bucking it like a caught fish reluctant to come into the boat. There were plenty of times when he couldn't see her at all for the blast of the tug's rockets, but the flames were so compressed usually that he could see enough.

"Steady as you go," he said to Ben, and sat down on the transom to relax. He closed his eyes and lay very still for a time. He had taken a worse pounding than he had bargained for. The almost damped-out cosmic surges swept through him rhythmically, gently urging him to sleep. But within an hour a buzzing called attention to the telescribe. The long expected flood of distress signals was beginning to come in. He got up wearily to listen. As soon as they were rid of the *Berenice,* they would be going after one of those.

The first two were distant—in the Jovian area. Then came a cry from the *Proteus*. She and the *Comet Dust* were out of control and caught in the same vortex. They were being whirled to

their mutual destruction, circling one another, ever approaching. In the end they would be pressed together into one amorphous lump. A vibrant call came from the *Ertrella Verde,* four weeks out of Oberon, bound for the docks of the Assay Office with an unspecified cargo but one valued at forty-odd millions. She was short of fuel and caught in the sweep of the trans-systemic tide of "highs" and "lows." Her last call stated she was falling helplessly head-on into a cluster of asteroids. She reckoned the asteroids to be the anterior Trojans, but she could not identify the one immediately ahead of her. Then came an urgent message from the Spanish Star Line, her owners, guaranteeing her value and begging that a salvage vessel be sent to her with all dispatch.

IV.

CAPTAIN VARMS, disturbed by the insistence of the buzzers, stumbled into the control room. His eyeballs were red with heavy slumber and his hair rumpled. He picked up the telescribe tape and sleepily locked at it.

"Ah," he said, as the import of the last item waked him more fully. "This *Estrelle Verde* looks good. How are we heading?"

He scowled when he swung the periscope forward and saw the ruddy dot of Mars ahead. Then, perceiving the laboring of the *Kwasind* under the burden of her tow, he flipped the instrument around so he could look astern. He wanted to know what was on the line and Sam told him.

"Yes, yes," snapped Varms, testily, "but what's in it for us? Oh! Some more of your damned sentimentality, eh? Well, here's the answer to that."

Before either Sam or Ben could move a muscle, with a single sweep of his arm he struck open the hawser switch. The electronic capstan shrieked as it ran wild for the few seconds before its automatic brakes choked it into silence. Circuit breakers popped like cannon. The quivering green ribbon, stretching out astern on whose slender strength the lives of the poor humans in the *Berenice* hung, ceased to exist. The tramp slid away in the typhoon, once more helplessly adrift and without hope.

"In another hour you could have cast them off decently," said Sam as calmly as he could, though he was near to choking with rage. "I think there are women aboard her as well as her crew."

"Women!" sneered Varms. "So that's your game? Well, it's money *I* want. Give me enough of that and I can have my pick of women."

He came closer to his mate, full again of his old-time swagger.

"I've taken a lot of your lip, mister, and I fell for your line and let you have charge of the tug. And *this* is what you do. You're stupid—that's what's the trouble with you—stupid. Stupid as hell. You don't know what it's all about and never did. You were that way back at the academy when we hung the blame for that jug of hootch on you and they booted you off the Moon. And that day at the Ecliptic trials. You took off to do stunts—the high-and-mighty Mr. Truman, almost a captain, you thought. It was going to be a walk-away—the job was in the bag. You didn't even have brains enough to take a look-see at your ship. Did you think that I, your senior, was going to take it lying down? Why, you poor damn fool—"

SAM'S SELF-CONTROL crashed under the overload. His right flashed out and thudded against Varms' chin, and he followed it with a hard left that sent the captain spinning against the opposite bulkhead. Then, restraining the furious impulse that suddenly had seized him, he stood fast, watching the other with loathing while he staggeringly recovered and wheeled. But when Varms

faced him again it was with a gun in his hand.

"That will be all from you, Truman," he raged, his face livid with anger. But seeing Sam made no further hostile move, he quieted his tone. More coldly he taunted:

"Once a sucker, always a sucker. You've struck your superior officer now. For that I could shoot you down where you stand—I'd be commended for it. But I think I'd rather not. I like the idea of the Iapetian mines better, down there in the radioactive ores. It's not so quick, but it's very, very thorough. And it's unquestionably legal—"

Ben Tiggleman had done it as neatly as a cat pounces on a mouse. One swift leap past Varms, snatching the gun from his hand as he went by, and he was in another corner, covering the captain in his turn.

"What do you want done with him?" he asked of Sam, but not taking his eye off of Varms.

"Nothing, now," said Sam, quietly. "Chuck the gun out of the tube, Ben. We can handle him without it."

"You can't get away with this," muttered Varms as Ben contemptuously broke the gun apart and tossed its parts into the garbage slot.

"Oh, no?" countered Sam. "Let's wait and see what the courts say. If you want to be technical, so will I—it's a game two can play. That's not a bad idea of yours about the Iapetian mines, only it will be you who go, not I. I did think, though, that you were a better sky-lawyer. They told you, no doubt, when they hired you that you had the right to refuse assistance to anybody that couldn't pay, but what you evidently don't know is that *once you put a line on something,* you're responsible. When you cut that ship adrift you committed murder—wholesale murder."

"I didn't authorize the tow," retorted Varms.

"You are the captain of record and on board," said Sam pointedly. "The *Kwasind* did take on the tow. Laugh that off."

Truman spat disgustedly and strode from the room.

In his own quarters he sat for a long time on the edge of his bunk trying to think out the best thing to do. He did not regret for one moment his outburst of violent anger. He felt he owed his new skipper more than a pair of pokes, even if his position was technically weak. He had long suspected Varms as the cause of his misfortunes, but now, as always, he lacked proof. He shrugged that off as ancient history. Immediately, what was best to do?

He could, of course, turn back to Mars where they could air their dirty linen in the courts. Yet, as he considered that, he was not so confident that he could make his threat good. The law was as he had stated it, but there was still Martian procedure to be reckoned with. The *Berenice* had been sent to her destruction by Varms' act; true. But with her had gone also her crew and passengers. The only surviving witnesses would be himself and Ben Tiggleman and at Herapolis they would be handicapped by being at the same time under the charge of mutiny. Inter-Planetary Salvage, sore at having no fees from the vessel, could be counted upon to be vindictive—and its influence was strong.

Then too, it would hardly be fair to Ben and the rest of the boys to turn back now. The recent months had been lean ones and they were all depending on today's prize money for their subsistence for a long time to come. After all, his quarrel with Varms was largely a personal one and it would be unjust to make the others suffer from it. Sam concluded to let his reckoning with his old opponent wait and in the meantime to stay out of his way as much as possible. At least Varms was a licensed officer—he might muddle through the

storm somehow. In the mood Sam was at the moment he didn't really care; the *Kwasind* could lose all standing, for all it mattered to him.

Too restless to sleep and resolved to stay out of the control room, at least until some emergency required his presence there, he wandered through a back passage and into the generator compartment.

THE TWISTINGS, blazing sphere of iridescent flame dancing within the interlaced hoops of the mesotronic charger was a vivid reminder to him that hitherto he had had no chance to test out his sky anchors. In view of the conditions on board, it was unlikely that he could use them at all, yet he remained fascinated by their possibilities. But what would become of them if Varms and the slippery legal crew of IPS got the better of him? Perhaps it would be better to destroy them as they were. He could not stomach the thought of others appropriating *that* product of his brain.

But could he destroy them? Once those quintillions of quintillions of electrons were knit into one tight little ball, dispersing them otherwise than he had planned might be impossible. Their power of devastation, if suddenly released, was unthinkably vast.

He gazed thoughtfully at the writhing ball of concentrated lightning, as visible through the plates of thick lead that surrounded it as an ordinary light through panes of glass. All about it, radically pointed electrodes were pouring further billions of units of energy into the flaming mass. Already a yard in diameter, it would blaze for many hours, if allowed to dissipate in space, a miniature sun.

Suddenly, he resolved to dispose ot them. Better that. Inert and frozen, they might safely be tossed into the rocket exhaust. He beckoned to one of Ben's men.

"Kill that, and freeze it down."

He watched it shrink, the instant the flow of electric energy was cut off. First it dwindled to a ball, the size of an apple, the sparkling white of nearly melting steel. Then it shrank to half that size, still glowing ruddily. In the end, it would be a pellet the size of a marble, weighing many tons on Earth, cold and inert in a bath of liquid hydrogen. In that condition, it might be fairly safe to handle.

It would take hours, he knew, for that vibrant spherelet to become quieted enough to be plunged into the cold solution that held its mates. In the meantime there was nothing he could do but wait. Unwilling to resume the useless bickerings with his captain, Sam went back to his own room, threw himself into his bunk and slept.

HE STIRRED occasionally, half awake, disturbed by the mysterious heavings and queer motions of the storm-tossed tug. At such times he would wonder idly how an outfit as shrewd as IPS could have entrusted, for all its cupidity, one of its money-making craft to a man so inexperienced in the ways of gravitic gales. But hour after hour the laboring vessel got on—somehow—though he knew from the wail of the compensators that they must be well into the perilous depths of a "low.

In time, a persistent tingling and itching brought him fully awake. There was fever in his blood—he was nauseated and dizzy. He painfully opened his eyes and saw what he already feared—the dread rose glow of the zeta fire. His furniture was bathed in it, and when he struggled to his feet he saw his flash was faintly luminous. He managed to get the big jar of ointment out of his locker and spread its contents on his skin. The tingling eased, and he followed the ointment with windings of black adhesive tape until he was as swathed as an ancient mummy—he left

no opening except for eyes and nostrils. The hafnium carbide with which it was impregnated would keep out further rays—if they got no more intense.

He put on his spacesuit and flicked its compensator to going, too. In his preoccupation with measures against the rays he had hardly noticed the pulsations that racked him, but his ribs were painfully aware of the recurrent pressure. Varms must have taken them into the very middle of things.

He went into the control room, half expecting to meet Varms' flailing fists with his own, but the captain was seated dejectedly at the master panel and staring at the visiplate. As Sam entered the room, a huge compression wave smashed them both, but receded as Varms managed to shove a lever all the way over. He had learned a few things, evidently, Sam thought bitterly. He knew from the vibrations of the floor plates that the emergency set of tubes was blasting, and he could see that the control room, like his own, was filled with the pale rose zeta fire. Varms' hands and head glimmered with the telltale luminescence.

"You had better go in my room and grease yourself with anazet," Sam said to him. "Then put tape on, like I have. The roll is lying in my bunk."

"There's a fortune down there," said Varms, huskily, pointing to the visiplate, "and we can't reach it. Every time I get down to a certain level, something grabs us. With all this power you'd think—"

"Snap out of it man—you're dying. All the fortunes in the Universe won't be any good to you in another ten minutes unless you do as I tell you. Let the fortune wait."

Sam shoved him out of his seat and led him halfway to the door, and saw him go falteringly from the room. A swift check with the rotor room showed that Ben and the boys were alert and in good condition; there were no pink rays down there. Sam went back to the instrument panel and made some adjustments to the set-up that materially improved conditions within the hull. The rosy fire died out and it was easier to breathe. Then he began to study the visiplate.

There was a planetoid landscape below—a wilderness of high-flung crags and black ravines. In places were accumulations of white crystalline matter, but nowhere were there signs of life. He had no idea what the body was named, but its hallmark of peaks and chasms was an easy one to read. It was one of the Trojans the wildest and roughest of all the little worlds. The *Kwasind* was evidently in an orbit about it, for as he looked, the scenery shifted. In one spot he saw what may have been once a warning beacon and lighthouse, but it was crushed beyond sure recognition.

When he was nearly back to where he had first taken over, he saw the particular bit of carrion the buzzard had had his eye on. Hung in the crotch of twin jagged peaks lay a huge spaceship, easily identifiable as one of the Spanish Star Line, despite its crumpled bow and caved-in stern. Sam could see the details plainly even though the distance was great, for Varms had been using the highest magnification. The middle section appeared to be intact, which was not surprising. That was where they carried their cargo. Tightly packed ore yielded very little to compression.

The *Kwasind* went on, then slid away on what under ordinary conditions would have been an orbit about the asteroid, but Sam soon saw that that body was receding at a terrific rate. He found he had to use the utmost power to bring the tug back onto a closed curve. The extreme eccentricity of her path was unquestionably due to the peculiar combination of gravite forces. There was the natural attraction of the planetoid, tremendously heightened by

the effect of the storm; and there was also the drift across it of pseudogravitic forces, tending to force the tug down on the "high" or weather side of the little body. On the lee side, the two forces were opposed. The waves of the storm threatened to tear the *Kwasind* away from the asteroid altogether.

V.

SAM TRUMAN became so fascinated by the difficulties of the problem that he forgot entirely his recent fight with the captain and lost sight of his own anomalous position on board. The vision of the immensely valuable, yet quite inaccessible, *Estrella Verde,* was a challenge to his professional pride. He found himself avidly wanting to go down to the wreck and make fast a line to it. The greed that so strongly motivated Varms did not enter into his calculations —he needed money, certainly, who doesn't?—but the thing that piqued him was being so near and yet so far from that mess of crumpled alloy that they all wanted to take hold of.

He glanced through the log and took off from figures—figures of the compensators consumption, and rocket use. He plotted curves. They were not reassuring. They were still rising and that meant the height of the storm was still to come. It was already impossibly dangerous to go close to the wreck. Perhaps he would have to wait until the little planet had made a half revolution and brought the fallen *Estrella Verde* to the lee side. But he did not know the name of the planetoid.

He ran back through the telescribe record and found the first S O S, that had been sent ten hours before. Presumably the ship was wrecked under the same conditions as existed now; therefore, it would be five hours before it could be safe to approach her. But could he hold the *Kwasind* in the vicinity that long? Any moment the gale might tear her away and fling her headlong spaceward. It would take many hours to fight back.

He paced the deck, frowning in mental calculations of time, stresses and rocket power. At the buzz of the teletype monitor he mechanically seized its tape and absent-mindedly read what was on it. Then, alert, he reread it. It was an intercept from IPS to the *Thor,* the *Thor* having already brought in one prize and was out now cruising for another. They were giving him the location of the *Estrella* wreck—none of the other tugs had reported salvaging it, and it was a nice prize. *Thor* said she knew about it and was on her way there.

Sam sprang into action. Ben came in response to his imperious ring.

"It's now or never, Ben. Slip those anchors into the electric oven and start exciting them. We'll try skyhooks over that ship. If they hold, you'll be on Easy Street."

"And if they don't?"

"Ben, the *Thor's* on the way here! We've *got* to get a line on that baby before she comes, or it'll be the same old fight over again. We lost every other time. Her skipper didn't marry the manager's daughter for her beauty. You know what a chance we have when it comes to rulings on split fees."

With great difficulty Sam brought the *Kwasind* up into the torrent of gravitic impulses and inched his way back to the planetoid. He dreaded getting around between the little Trojan and the oncoming waves, but there was nothing else to do—unless he wanted to chuck the whole job as being too tough, and scurry for shelter.

The moment the tug was steady on her course and there was no more he could do to coax her, he left the controls and went to watch the heating of his little pellets. They were dazzling white by the time he put his eye to the peephole in the furnace wall. A few

hundred degrees more and they would be ready to act.

SKY ANCHORS had long been the dream of astragators. And also the subject of many jests. Some sort of celestial drag was needed, but no one had perfected one.

"I know what's in 'em, I helped you make 'em," said Ben, "but I still don't see—"

"Just like the force screens in battle cruiser work," said Sam, confidently. "They accumulate balls of pure energy and fire them out on tractor threads. The yank of the tractor thread, when it has run its full length, sets off the radiation. The tendency of the energy is to escape from the nearest center of gravity, see? But its nucleus is held fast by the tractor thread, and it can't get away except by dissipating itself in radiation. As long as it lasts, it not only exerts a pull on the cruiser, but repulses whatever comes against it from the outside. They shoot out a cloud of them all around, which balances the stresses on the cruiser and gives it perfect protection."

"Yeah, but—"

"Get your tongs and a gang of men and let's load these into the heaving line tubes in the upper hemisphere. You'll have to attach a tractor line to each of them, like harpoons. Come on, I'll show you."

Sam ran back and checked his position. They were almost over the broken carcass of the *Estrella Verde*. He had already computed roughly what the gravitional pull was, and knew about what to expect from each of his anchors.

"Number one tube—three—five. Fire!" As he called, he cut his rockets. It was the supreme gamble. Ben had already pressed the three buttons and was crowding up beside Sam at the visiplate, focused upward.

Three skyrockets, each at a slight angle from the vertical and equally spaced horizontally, soared upward. Each of the three blobs of radiant energy trailed a shimmering ribbon of pale-green fire, the lines that were to hold them. Harpoons they were, of blazing light, and as the green lines tautened at the end of their runs, the snubbed spherelets burst into huge globes of fiercely iridescent light.

"Hang on!" yelled Sam, as the *Kwasind* shivered under the shock. It was something like a collision with a heavy solid. The tug swayed, sickeningly, after slowing to a stop and then reversing its motion like a gigantic pendulum. Sam threw the periscope through a full half circle to bring the planetoid into view. Its image was large on the plate and growing at a rapid rate. That meant they were falling, straight down onto it.

"Two more, any two!" sang out Sam.

That time there was scarcely any shock, but the image of the planetold ceased to grow visibly. Sam set a pair of huge dividers and measured its breath. In a full minute it grew but a few degrees.

"We are still falling," he observed, but there was enormous relief in his voice. "That's what I want to do—until we are nearly to the wreck. But we're under control now. The last one will do it. Gosh! It's lucky we made six." And he grinned happily at Ben.

Ben had not lost the puzzled look, though.

"Now look," laughed Sam, exhilarated at his success. "You remember toy balloons when you were a kid? Well, imagine five of 'em with a brick tied to 'em. That's us. Those five chunks of energy up there are trying their best to get away from the nearest center of gravity, and at this spot that happens to be the asteroid under us. They're not strong enough to do it, so we are slowly falling. When we get down to the

right height, all we have to do is fire the last one, and we'll be all set. Any little adjustments necessary we can make with rockets."

BEN TIGGLEMAN understood. He also understood why Sam did not want to descend all the way. They were in the same situation that a ship in water would be under similar circumstances—hanging to a seaward anchor off a rocky lee shore. To get closer, unless very delicately and accurately done, was to invite being dashed to pieces on one of the pinnacles. Moreover, all that was needed was to get a line to the wreck and as soon as the storm abated, haul off to skyward with her in tow.

"Now," said Sam, "there's one thing we *don't* know. That is, how long will those anchors last? We gave them a four-hour charge, but they may discharge at a faster rate. And when they have dissipated— *Bang!* With all rockets going, the best we can hope for is an easy crash, and you can see for yourself what kind of ground is under us. I am going down and fasten a hawser to that wreck. Then, if there's a break in the weather, all we have to do is pull out."

Ben nodded, but he could not fail to see that their situation was still pretty risky. He hadn't thought about the short life of the anchors. But then, they might get out—the weather might improve. And the *Thor* was on the way. He agreed that the line should be run, and quickly.

"I'll need a surfboat for this, and a couple of the boys," said Sam.

Unexpectedly, Varms, swaddled in hafnium tape, appeared in the control room.

"What's going on here?" he inquired, petulantly. Apparently the filtered rays had not operated on him long enough to set up the inflammation that would rot away the flesh.

Ben looked rattled, but Sam took the bull by the horns, deciding on the instant to try another tack. The proof of his anchors hung in the balance. If they worked, impossible rescues became easy.

"If I can salvage that ship you wanted without your having to lift a finger, will you make a concession?"

"You are going to the Iapetian mines, if I never see another dollar," snapped Varms, viciously. " Concede nothing. Whine all you want—"

"As far as your fight and mine is concerned, Eric, I don't want your concessions. At Mars, it will be whole dog or none. But it's Ben and the boys I'm speaking for. They need money. And you'll get yours, too. What I'm asking you to do is to leave Ben alone—both now and when we get back. He hasn't hurt you any, so forget his part in our row. If I'm going down to that *Estrella* to tie a line on her, I've got to have somebody up here handling this end that I can depend on. Lay off of him until I get back—that's all I ask. *You* can't lose."

"Oh, that dumbbell," said Varms, contemptuously. "I'd forgotten he was alive. No, go ahead and do your stuff if you're so damn anxious to show off. As you say, we can settle when we get to Herapolis. As far as your fat boy friend goes—"

That was all Sam wanted. His concern was immediate; he didn't want Varms jockeying with the controls while he was hanging outside on a sliver of an electron beam. As to Varms' promise not to charge Ben with mutiny, Sam attached no value to it at all, but it was at least a try. He was willing to rely on Varms' greed not to interfere with his own efforts to salvage the *Estrella,* once he had pointed out the folly of his trying to interfere.

Sam's motives were not altogether as altruistic as he thought them. He did want to see the boys go back with something to show for their work, but

primarily he was concerned about the success of his anchors. Now that he had put them to the test, he wanted to see it through, and that with the minimum of interference.

The quiet inside the suspended ship was deceptive. Ben had already fired the sixth and last of the sky-hooks, and she hung motionless a bare thousand feet above the wreck, all her original orbital velocity gone—the pendulum motion ceased. Sam followed his tow men into the boat and, before they cast off, worked it under the belly of the *Kwasind*

"The tug's going," he shouted, running toward Truman. "They're marooning us!"

and welded on the end of a tractor line to ease their descent.

It was well they did, for gravity was strong and its surges violent. Yard at a time Ben fed them slack, lowering them away. Down below, the threatening needles of the two peaks stabbed at them, and between they could see the dim outlines of the stranded treasure vessel. Patches of pink fire were everywhere, evidence that the storm was still going strong.

Sam fended off the torn and warped plates of the *Estrella Verde's* smashed nose. The boat came to a grating landing on the cold rocks beside it. He stepped out and looked at the monstrous ship, looming doubly large in the half light and by contrast with the thin crags of Trojan rock.

Above, like some fantastic fireworks display, the black button of the *Kwasind* stood atop the thin green line that led up from the boat, and branching upward from it were the brilliant taut lines that clung to the anchors. Those glittering objects formed a marvelous six-point constellation in the skies, flaming fiercely as they radiated away their pent-up force into the heavens. Sam signaled his safe arrival, and the green link between him and the tug flickered and went out.

VI.

SAM'S PRACTICED EYE surveyed the broken ship. There was no possibility of towing her out intact. The bow was a mass of tangled wreckage, while the stern section appeared to be torn clean away. But the cargo segment amidships appeared to be sound and its end bulkheads undamaged. Sam decided to attach the hawser to it directly.

He and his helpers crawled out over the convex surface of its top where the rosy flames danced six inches high on the iron of the hull. Dragging their torch behind them, they made their way to the spot where the line was to be made fast.

Sam feared for their eyes, for those they could not tape. As a precaution, they took turns holding the torch, a few minutes each, while the relief pair nestled together, each sheltering his eyes against his mate's body. It was awkward and tedious work, and all the while the gravitic surges played upon their helpless bodies as on accordions. But in time the preheating was done and Sam gave Ben the signal. Scurrying to a safe distance, they watched the fat, greasy stream of verdant brilliance smash down like a bolt of lightning and seize the wreck. Now the *Kwasind* was steadied from below as well as from above. Even better, she was secure in her legal rights. Let the *Thor* come.

Tiresome as the descent and the heating had been, it had not actually taken long. The slow-moving asteroid still presented the wreck to the full force of the gale which showed little sign of abating. It would be hours before the *Kwasind* could lift. Desiring to make sure that the end doors of the cargo section were dogged tight, Sam decided to stay down a little longer and phoned aloft to Ben to that effect. Ben assured him everything was all right in the ship and the strain on the anchors evenly distributed. He also said there was no need of haste, as he had reported having a line on the *Estrella* and the *Thor* had turned elsewhere for her prey.

Sending the men to the shelter of the surfboat, Sam undertook the inspection of the cargo holds. To his satisfaction, the doors at the end were sound and unimpaired, but before closing them for the trip in, he wandered through the longitudinal passage between them to examine the cargo itself. He was curious as to its nature, since it had been reported to have such an enormous value.

The first two bins, to his amazement,

contained nothing but tribonite—virtually ballast. Although some of the other bins were filled with rhodium ore, all of it together could hardly have been worth five million. Yet they had reported the ship as valued at ten times that! Could the S O S have been garbled?

Puzzled, he determined to explore the torn and disrupted bow. Somewhere in its wreckage there would be the ship's papers. Those would surely show what things of value there were on board.

Before crawling beneath the warped plates of the bow structure, he stepped outside and gazed critically upward at his six blazing sky anchors. He was gratified to see they were holding up well, and any remaining anxiety he had as to their dependability left him. He found a rent in the forward hull and squirmed through it.

In the gloomy and misshapen compartments ahead of him he found many horrible vestiges of the storm's ravages. There were some of those sickening dolls—a dozen of them—pygmy caricatures of men. They were corpses, bodies of normal men like himself, but crushed uniformly by the overwhelming gravity that had had its way when the compensators stopped and the hull walls failed. He shuddered and passed them by. He had seen such things before, but he had yet to become callous to them.

On what had been the floor of the control room he found among the débris what he had been looking for. In one place was the log, in another the manifest and muster roll. Playing his flashlight on them, he thumbed their pages, but nowhere did he find mention of other than the cheap ores he had already seen. He had almost come to the conclusion that the amount stated in the distress call had been an error when he came upon an entry made the day before the ship cleared Oberon. It referred to the payment of an insurance premium against piracy—an amount so large that it could only cover an important shipment.

THE RECEIVER in his helmet crackled vigorously, but the voice that should have followed his acknowledgment did not immediately speak. Then he could make out a screamed, "Look out, Sam! I can't hold—" and Ben's warning was choked into stillness. The crackling stopped. The line was dead.

Something must have happened to the *Kwasind*—perhaps the anchors were dying out. Sam hastily made his way through the jumble of twisted stanchions and stumbled over buckled floor plates. In his alarm, it seemed ages before he could gain the crack by which he had entered and look aloft to see what was wrong. When he saw, he sprinted for the surfboat and shook his waiting men into alertness.

Overhead, still hanging from the six gleaming anchors, the *Kwasind* was all too evidently getting ready for action. Her underjet bushings were glowing white, and even as the startled men on the ground stared, straw-colored fire gushed down at them. They scrambled frantically for the shelter of a nearby ledge and cowered there while the incandescent rocket exhaust smote the place they just had been. They saw their surfboat burst into flames. The *Estella Verde* heaved upward, hogging noticeably as the cargo segment rose, pulled by the strong hawser. Huge fragments of intertwined wreckage, the last clinging fragments of the ruptured bow and stern, fell away as the amidship section was dragged skyward. The *Kwasind* was under way—was running off with their prize, abandoning them!

Sam Truman's phone again crackled, alive once more.

"This will do as well as Iapetus," said an exultant voice. It was that of Varms. "Dig a mine where you are."

The connection clicked.

"The dirty louse," said one of the men.

They stood silently watching the Mars-bound tug and its tow, now a ruddy streak against a handful of dwindling stars. Sam set his face in grim chagrin as he realized what had happened. He *had* been a sucker. He saw now what he should have known all along. He could have hauled off before, if he had only thought of adding the lift of his anchors to the force of the rockets. His mistake had been in thinking of them only as anchors, when in reality they were assistant tugs, pulling always. Varms must have doped it out, overpowered Ben, and gone. Sam groaned inwardly at this crowning humiliation. It was bad enough to be marooned on a bleak, rocky Trojan, but he had to face the fact that it was by his own acts—his providing the anchors, his securing the towline, his unpardonable tardiness in returning aboard—that had made it possible for Varms to decamp with the salvaged ship.

By that time he was aware that the two silent men beside him were awaiting orders. Something had to be done now. It was Sam who must give the word. It was a gloomy prospect. They had no boat and there was small promise that in the remaining wreckage of the *Estrella* anything of use to them could be found. In the cursory examination he had made of the planetoid as they had approached it, Sam recalled he saw no signs of life. Rather there was an abundance of evidence that the storm had killed whatever life had been there. But at least the weather was beginning to moderate. The zeta fire was very weak and in many places it was entirely absent. The improvement was due in part to the revolution of the body on which they stood—they were more in its lee now—but even a "low" passes after a time.

"Let's see what they left us," said Sam, leading the way to the scattered and tumbled remnants of the *Estrella Verde*.

THEY FOUND lean pickings. As for the bow, after its second crash it was an impenetrable jungle of junk. In the stern, intact and unmoved by the departure of the *Kwasind*, they came upon rows and rows of fuel drums. Those were in the after keelson, the reserve bunker. The macabre dolls scattered about told the story plainly enough. Men had ben getting up their ultimate supply of fuel when the ship struck and doomed them all. But the fuel that remained was of no value to the marooned tug men. They had no boat nor had any of the *Estrella's* survived. What foodstuffs they could identify had been squeezed to such incredibly compact pellets as to be unfit for any use.

But while the men were prowling through the broken stores, Sam kept his eye peeled for the telltale box of lead. Radium, he geussed, was what the concealed treasure was, and hidden, probably, in the keelson as a further precaution against piracy. Or at least it was one of the radioactives. In any case they were likely to put it as far as possible from the place where men lived and worked, and away from the fields of the huge electric machine.

At last he found it, and called to his companions. They watched in quiet awe while he ripped open its cover and exposed its contents. In neat tiers lay dozens of small white metallic bricks. Uranium 235! The most compact and economical source of atomic power—enough of it to disrupt the Earth itself. The value they had given out over the Omnivox had not been an error; it had been an understatement. Here was wealth beyond their wildest dreams.

It was all theirs, too, for the law on salvage classed what was left behind by a chartered salvager as junk. Whoever

found such leavings took title. When Varms left as he did, he renounced for the IPS and himself, as well as the original owners, whatever claim for ownership they might have possessed.

It was one of the men who laughed first, but in a moment they all were rocking with merriment. The irony of the situation was too acute to miss. Tumbled carelessly on the ground by their knees was this vast fortune, while all about was the stark, wild darkness of the storm-devastated Trojans, in which the moment the last scant provisions in their pockets were gone, they would die.

What Sam laughed at was his picturing of the manager's greedy face, and that of the snaky Varms, when they went to settle with the owners and found that they had carefully towed in the dregs and left the cream behind. He sobered as he recognized they would promptly send an expedition for it.

He thought of concealing it, but he knew that was no good. The stuff was radioactive and instruments could find it. Tossing it into the depths of the adjacent canyon was as useless for the same reason. Yet they could not hope to carry it with them, both on account of its weight and of its emanations. Their means of locomotion was strictly limited now. They had only the hand rockets of their suits.

VII.

AN EXPLORATORY cutting down of their suit compensators showed them the surges were far apart now, and light. It would soon be calm. They lashed themselves together, pooling their rockets.

They soared easily over the scraggly ranges and looked down into great yawning crevasses, but seldom did they see a ledge wide enough for a goat to stand upon. They went on, hoping against hope, exploring the polar regions of the body—the areas that had not fallen under their observation while aloft in the tug. Finally one cried:

"Light-ho!"

There was a light, nearly ahead, which neither of the others had noticed, due to their inspection of the ridges and caverns beneath. It was a tiny light, such as might be expected in a dwelling. It was in the midst of a vague gray shape. As they headed more directly toward it and decreased their altitude they could make out the outlines of a small ship's hull. Some tiny craft, a yacht, probably, was down there and the light marked its entry port.

Cutting their bonds the moment they grounded before the lock, Sam rapped sharply on the ship's hull. The outer lock face slid aside and the three tug men stepped within. As the inner door let them into the ship, they faced a powerfully built, red-faced man of about sixty. He took one look at the IPS monogram on Sam Truman's helmet visor and bellowed:

"No! I don't want salvage. Get out of here and take your pack of bloodsuckers with you!"

It was a disconcerting reception for the three castaways, but Sam stood his ground and began an explanation. After his first few sentences their host dropped some of his ready belligerence, and as he began to get the drift of the story he invited them into the cabin and made them comfortable. Sam related the main events leading up to their marooning, not elaborating his feud with Varms, except to give an account of the quarrel over the casting off of the ill-fated *Berenice*. Nor did he see fit to reveal the cache of uranium they had left behind.

"Ah, that's different," said the old man, at last. "Well, you're welcome here until my tender comes, though God knows when that will be. But I'd stay here until hell froze over before I'd deal with Inter-Planetary. My name's Ethridge—Jovian Mining Syndicate, if

you ever heard of that—and this is my yacht *Norma*.

"We snugged in here early in the blow, and outside of being practically out of fuel, we're all right. Our radio's crushed, so we can't communicate, but I've got all my life ahead of me—sooner or later a lighthouse tender'll come snooping around, if my sons haven't looked me up before. When you first popped in here, I thought you wanted to give me a tow, then bleed and blackmail me for the rest of my life on account of it. No, sirree. Charlie Ethridge doesn't play the game that way. I'll wait, if I have to, all—"

"I have plenty of fuel, Mr. Ethridge. It's in drums. Lend me a boat and I can fuel you right where you lie. It's a tricky landing up there for a ship."

"What's the catch?" demanded Ethridge, suspicious again. His distrust of men in the IPS uniform was long-standing and deep-seated. "That's IPS's wreck, isn't it? I won't be billed by them, I tell you."

Sam explained the legal status of the wreckage and all that was in it. Sizing Ethridge up as a man of power and wealth who nursed a personal grudge against the equally powerful salvage company, he decided on the instant to tell him frankly about the uranium. His offer was to fuel the *Norma* in return for the transportation of himself and shipmates to the nearest port, with their personal possessions—the treasure.

"Certainly, my boy. An eminently fair proposition. Get about it at once, and take such men of my crew as you may need to help."

HERAPOLIS SKYPORT was coming up on the horizon of Mars. Ethridge's sailing master was handling the landing. The old man offered his guests a final drink with the toast, "Here's to the confusion of our enemies."

"By the way," he asked, as an afterthought, "when that tug of yours was hanging in the sky up there over us, what was that mess of fireworks over her? Looked like a corona of stars from where we lay."

Sam explained the sky anchors.

"Hm-m-m," commented Ethridge. "Never heard of such a thing. Why couldn't I use those getting my ore scows up from the surface of Jupiter? We have the devil's own time now, what with the gravity and all. When you get through your rat killing down there, come back and talk to me. I think you have something there."

Upon stepping out onto the landing field, Sam was astonished to see that the ship in the next cradle was the *Berenice*, her bow tubes still smoking from her recent landing. Her passengers were pouring out of the lock, grateful to step on solid ground again. Sam paused and asked a few questions. He learned that the lift he had given them had been sufficient for them to get the vessel under control again. By the time she was cut off she was near enough the edge of the "low" to fight her way out of it. It had been a hard battle, but when the gale had subsided they retained enough momentum to drift into Mars and land, but with only a quarter of a barrel of fuel to spare. Captain Tribble, they told him, was indignant at the *Kwasind's* inexplicable reversal of action and had gone to the Dome of Justice to make a formal complaint of it.

Sam hurried on to the IPS yards. Inside them he found everything seething with excitement. The manager was waddling up and down, happily rubbing his hands together in avaricious anticipation. There was much lucre about to fall into his coffers. Two hours before, the *Kwasind* had appeared in an orbit outside Deimos and asked for other tugs to relieve her of her ungainly tow. The flotilla were expected to land momentarily.

Sam was astonished at the unaccountable delay in the *Kwasind's* arrival, for

she must have left the storm-swept Trojan a full week before the *Norma*. He was not to know until later the reason for it, but it was his sky-hooks that had done the trick. From the moment of their planting they had been attempting to escape the asteroid and that naturally, radially. But while at the time of their setting the direction of their pull was Marsward, in the interval to Varms' hasty departure the planetoid had made a quarter revolution or more about its axis, with the consequence that when the anchors were free to run away, they pulled violently in an altered direction. They proved to be far stronger than the rockets, and although Varms blasted angrily with every imaginable combination of rocket angles, by the time they burned out he was millions of miles on the far side of the Trojans, very much muddled as to his bearings. No one had told him about the anchors, so he had no understanding of why the sturdy tug persisted along its unique cycloidal trajectory.

Ben Tiggleman could have cut the threads that held them, but all that time Ben Tiggleman was lying face down in a locker, bound hand and foot.

A BLACK PRISON van was parked by the side of the *Kwasind's* landing cradle and a couple of stern-faced Martian hounds of the law were there, one of them suggestively jingling a set of irons. Mutiny aboard, the incoming tug had signaled—mutiny and desertion. One of the desperate ringleaders had been overcome and confined, her message read, and the vesssl was shorthanded; but her brave and resourceful captain was bringing her in, regardless of such trying difficulties.

The *Kwasind* was just landing. As the crowd eased back to escape her skirts of flame, Captain Tribble arrived with a black-robed functionary of the court. In company with them was Mr. Ethridge, looking pleased as the cat that licked the cream. They spoke rapidly and earnestly with the puzzled gendarmes, displaying papers with dangling seals. The two officers finally understood and nodded. The entry port of the *Kwasind* slid open and out stepped Varms, dragging his bound engineer behind him.

"Here's your man—the others deserted," he said imperiously to the cops, and pushed the goggle-eyed Ben Tiggleman forward.

"Thanks," said the senior of the two officers, laconically. But he ignored the trussed-up Ben and shoved past him. With a quick snap he fastened the bracelets on Varms instead. "We know all about you, old-timer. This way!"

They shoved him, struggling and protesting, into the wagon. A door slammed, a lock clicked, and the Black Maria rolled away.

EPISODE ON DHEE MINOR

The local natives weren't exactly immortal, but on the other hand they didn't exactly die—!

By Harry Walton

Illustrated by Wesso

INSIDE the low sheet-metal commissary building of the space post known on the Interplanetary Relations & Commerce Commission's roster as No. 291, Oliver Blakston grumbled within his air helmet—where, to be sure, there was nobody to hear him grumble but himself. All space-post factors grumbled, as a matter of traditional right. Besides, it helped to pass the time between customers, and when these number only a score of prospectors, a dozen Martian spore gatherers and looth wool shearers, and one aged, slightly senile fugitive from justice, there is plenty of time to pass.

"Why in the name of thirty Plutonian devils I stay here, I don't know. I've seniority enough to pick a dozen better posts. On colonies where you can breathe air that didn't come out of a can, and eat food that doesn't taste like it was dragged out of Old Faithful. This time," he swore, "I'm quitting. Six days more and I'm pulling out of this stinking sulphur hole—"

He'd said it before, he knew. He always asked himself the same question, arrived at the same decision, just before the monthly supply ship arrived. And when it did, inevitably he found too many things to clean up before he could leave, and would grumblingly announce that he had decided to stay "just one danged month more." Spacemen grinned when he said that. He'd stayed "one danged month more" for eight years now. But this time, so help him, he meant it.

One by one he polished the shiny little oxygen cylinders comprising the most important item of his trading stock, cursing all the while the tarnish and corrosion wrought by this alien atmosphere. A blend of nasty gases that smelled just as bad if lumped under one name—hydrogen sulphide. You smelled the characteristic rotten-egg odor thirty-two hours a day—and the day of Dhee Minor was just thirty-two hours long. The smell seeped through air conditioning and filtering systems, past double-seamed metal walls and lucite helmets, through rubber, cloth and glass. The atmosphere was poisonous, but the odor itself was demoralizing. It had been years since Blakston had seen a hen's egg, but he knew that never again would he be able to swallow a mouthful of one.

He grumbled about the smell, swore sulphurously at every spot of tarnish which he painstakingly rubbed bright. But his grumbling was automatic by now and had little to do with his thoughts. Mentally he was counting the full cylinders on hand, noting the number of empty returns, estimating what quantity he should stock of this article and that for trade throughout the coming month. He used no notes, made no errors. His mind was an orderly file that would empty itself of nonessentials

the moment current orders had been filled.

Bending over the oxy-cylinders, he felt the scrape of the door being opened, heard the characteristic shuffle of an Ootlandah, and looked up to recognize Queel, a native of the planetoid and one of the reasons Blakston always stayed "one danged month more."

Properly speaking, this wasn't Queel. Queel had died six and a half minutes after Blakston first met him, six years ago. This was a remote descendant of that Queel, and a less remote descendant of the Queel Blakston had seen two days ago. Literally, Blakston had never laid eyes upon the Ootlandah who now waddled into the commissary and stopped, quivering as though blown by an invisible breeze, before the long thurkwood counter.

THE CASUAL EYE would have described Queel as a perambulating vege-

The batteries were exhausted —the vast beast no longer feared the crook!

table. An elongated oat grain, enormously magnified to the size of a small Earth man, would have looked like Queel—or like any other Ootlandah, for that matter. Spacemen marveled that Blakston could tell the natives apart. Queel was curiously bearded; his whiskers sprouted up from his waist and fringed his tiny, gourdlike head like the calyx of some fantastic blossom. He had two little eyes and a mere slit of mouth, yet so flexible were his internal organs that he could imitate human speech to a nicety, although in a reedy tone. Furthermore, hours spent listening to Blakston's reading of books, newspapers and space-post communications had given Queel an immense and sometimes startling vocabulary, which he enjoyed using in unique fashion.

"Queel the elder respectfully salutes you," chirped the native. The atmosphere carried the sound, and Blakston heard it well enough, for his helmet was fitted with air-tight sound diaphragms as well as the conventional radio communicator.

Blakston grunted amiably. "Queel the elder" was a stock phrase, indicating that the individual now present had lived out more than one half of his normal life span. It was a courtesy appreciated by Ootlandahs to acknowledge the information.

"For a can of apcots," Queel went on in a businesslike tone, "I have to exchange two large Keela-fungi. Is trade okey dokey?"

Blakston smacked his lips. A real treat at any time, Keela mushrooms were a delightful change from canned food. "Trade is done," he said gratefully, and walked out to find his part of the bargain, two enormous puffy parasols, lying beside the doorstep where Queel had left them. Blakston grinned at the characteristic pride of the Ootlandah, who had plainly carried them thus far, perhaps for miles, but who, for no amount of "apcots," would have let himself be seen in the act of burden.

Blakston brought the Keela in and shoved them into the desulphiding chamber to be ready for supper. He selected a large can of apricots, added, by way of bonus, a strip of tough licorice from an air-tight glass jar, and passed both to Queel, whose whiskers quivered with delight at the gift.

"Am most thankful," he squeaked. "But regret imminent passing which you will have to witness— Look out!"

The warning was timely, and Blakston instantly made ready by whisking a handy cloth over the stock on the counter. The Ootlandah shook himself, his tiny green-rimmed eyes mournful. Then, with a sudden upheaval of energy and to the accompaniment of a sound much like a sneeze but signally more violent in effect, he shivered himself asunder. The oatman, whiskers and all, disintegrated to a fine dust that settled slowly to the floor. Blakston waited patiently for the miracle he had seen a hundred times but still found fascinating.

From the center of the little pile of yellow powder sprouted a small yellow pod, rapidly expanding like a toy balloon. Swiftly it assumed larger proportions, prickled with growing whiskers, grew reedy little legs with flapping pads of feet. Within sixty seconds there stood complete an exact replica of the deceased Queel. This explosive life cycle completed, the newborn spoke.

"Queel the younger salutes you!"

BLAKSTON again grunted acknowledgment. Queel the younger would find that sufficient, as his ancestors had before him. For this Queel possessed all the accumulated memories of hundreds of his direct forbears. For all his fragility—he weighed scarcely twenty pounds Earth gravity, and not a tenth of that on this tiny world—Queel was a triumph of evolution. He was, in his own way, immortal.

"There is news," continued the native. "Approaching from sunward is great looth. Beware, man friend!"

Blakston thanked him, inwardly smiling at Queel's melodramatic manner. But the warning was born of the Ootlandah's not unfounded fear of the genus *loothaguri,* which might be described as an acre of animal with but one characteristic—an appetite. The factor himself felt no anxiety at the approach of one of these weird creatures, for the space-post's electrical fences could turn aside a dozen of them.

Then came an apprehension that made Blakston wrinkle his nose in anticipation—the fear that the looth might get on the cleared landing field and be crisped in the rocket blasts of the supply ship. That had happened once, and the odor of burned wool, feathers and flesh was still vivid in his memory; like the sulphide, it defied masks and air purifiers. During that month, more than ever before, he had come close to resigning his post.

He frowned therefore over this remote but ghastly possibility. Hard as it was to imagine the smelly air of Dhee Minor made more obnoxious, grim experience had proven it could be done. He decided to force the ship's crew to fence the landing field against such eventualities in the future.

"Having reason to depart," commented Queel, "shall now do so. But listen!"

Blakston listened, fuming at the necessity for air-tight sound diaphragms, which always muffled sound a bit and now kept him deaf to whatever had attracted Queel's attention.

"Is sound of ship landing," supplied that worthy. And indeed Blakston heard it almost that moment—the thin whistle set up by the ship's plunge into Dhee's atmosphere, the distant roar of its barking blast. He breathed a prayer that it might miss the looth.

"Funny," he said. "The supply ship's early—it's not due for six days."

"Is no supply ship," remarked Queel positively. Blakston frowned his doubt, yet his own ears promptly confirmed the Ootlandah. The supply ship's landing screech was of a different timbre, its rocket blasts heavier, more sonorous. Blakston tore his binoculars off their peg, ran outdoors, and leveled them on the sky just over the landing field. A faint streak of golden-red flame, dimmed by the hot globe of the sun, flashed across his field of vision. The ship was down, out of sight behind the forest fringe, where the sun itself would sink before many more minutes. Blakston went back inside.

FIVE minutes passed. For the third time he polished the long counter, patiently busied himself with rearranging the oxygen tanks. The visitors would come, he told himself. Anyone who landed on Dhee Minor would come first of all to the space post. It was not only common sense, but unchanging precedent. On the opposite side of the counter Queel waited also, forgotten his announced intention of being off—for the Ootlandah was blessed with a huge share of human curiosity.

He stiffened, whiskers quivering, as footsteps thudded swiftly on the path outside. A man materialized suddenly on the threshold, bulky in spacesuit, huge in comparison to Blakston. A second figure appeared behind him, and both, after an instant's hesitation, entered the store. Blakston switched on his helmet phone, knowing that their suits would hardly be equipped with sound diaphragms, and offered routine greeting, to which both responded surlily.

"We're required to have a record of your landing," Blakston went on. "The I. R. C. C. requests all visitors to register. After that I'm at your service."

"Planetary patrol," growled the

smaller man, flashing a badge on the back of one glove. "Official business. Get your men together and we'll explain it to the lot of you."

"Men?" Blakston laughed. "I'm all there is, so far as the space post goes. There are a few chaps running around out there, God knows where—"

The laugh faded before sudden, chilling suspicion. Planetary patrolmen, with a complete, space-post roster on board their ship, should *know* there was no staff at 291.

"That suits us!" An unpleasant grin overspread the gross features of the bigger man. "Makes it easier. All we want is oxygen and chow—lots of it and quick. Where is it?"

Blakston's glance switched to the smaller man, a dark, bushy-browed individual with a face as lean and pointed as an animal's. His hand snapped up, cradling the butt of a proton gun whose needle-slim barrel fell in line with Blakston's chest. "You heard him," he said. "Get the stuff." His flat voice was expressionless—and as deadly—as the warning burr of a rattlesnake.

Hot and cold chills of fury rippled down Blakston's spine. To be robbed—of oxygen! The law required him to give it free of charge to anybody who lacked means of payment, and that was one thing. But to be robbed of it at the point of a gun— He trembled with impotent rage as he selected two full cylinders and thumped them down upon the counter.

"Take them!" he said briefly, furiously. "Get out!"

The burly man guffawed. "He doesn't get the idea, Chet. You explain it while I show him—" He swept Blakston aside as though brushing a beetle off his suit and began pawing through the stacks of cylinders, tossing empty ones to the floor, putting full ones on the counter, until the shelves were bare.

Blakston fumed at this treatment of his precious stock. Only the smaller man's proton gun kept him from assaulting the other.

"I gave you full ones," he gritted. "It's more than you deserve. Get out!"

"Aw, tell him, Chet," urged the big man as he worked. "Tell him we're taking all of them—"

All! The word dinned its fury and its import into Blakston's brain, an unbelievable and ghastly nightmare. To steal a single flask of the life-sustaining gas was the one crime blacker than murder on these airless worlds. Oxygen, out here, was the common currency of humanity, priceless as life itself. Even outlaws respected the unwritten law that exempted a man's oxygen from theft.

"Listen to me!" He made futile, clawing efforts to stop the giant, who was now strapping the full cylinders together. "The supply ship isn't due for a week—and there are men out there who'll be coming here for oxygen. Sometimes their tanks are almost empty; sometimes they're so far gone I have to hook the new tank on for them. That's what those flasks mean to them when—"

The giant shoved him sprawling, and began to load food into a burden net, clearing entire shelves at a sweep. The load was a tremendous one, yet no more than a strong man could carry, gravity on Dhee Minor being of the slightest.

Blakston turned to the smaller man. Whatever the two did, this one would dictate. But even as he spoke, Blakston felt the futility of any appeal to those merciless, reptile-cold eyes.

"Leave us four flasks at least—they'll do if the ship comes on time. Leave four, and I swear I won't say a word about you. But leave four—"

The giant grinned with evil humor, "You won't be needing no oxygen. We will. We aim to put a lot of room between us and Reinmuth before we shut off our jets."

Reinmuth! The word blasted all hope in one black instant. These were con-

victs, by some incredible chance escaped from the penal colony of that tiny planetoid. That was why they had landed here, seeking food and oxygen to stock their stolen ship for a dash to the outer planets. Once beyond Jupiter, no patrol in space could lay a finger on them.

The smaller man cursed in that queer, toneless voice of his.

"Aw, what's the difference if he knows?" whined the giant. "I tell you the whole lousy space-pill will go like a fistful of dry hay. That red stuff out there is like gunpowder. We dip our rockets here and there when we pull out, and *nothing* can put out the fireworks."

AN UNCONTROLLABLE shudder swept Blakston. They meant to fire the planet! He knew of the disasters of '35 and '87—holocausts that had swept two thirds of this tiny world and left only blazing stubble and charred death in their wake. Meteors, red-hot from their fall through the atmosphere, had started those. The planetoid's thick growth of vegetation had done the rest—for living stuff, here on Dhee Minor, was built of inflammable oxygen compounds, as combustible as a match head and similarly carrying within itself the oxygen necessary to complete combustion. A fire of any kind was forbidden by law; food was precooked, or, here at the space post, electrically baked. The entire planetoid was a tinderbox.

The convicts' plan was simple enough—and perfect from their point of view, thought Blakston bitterly. They would create a tragedy here that would effectively cover their trail, sacrificing a world to gain their own ends. Safe in their ship, they had only to fly low and allow the flames from their ship's jets to touch a few tree fronds here and there. Set alight in three or four places, Dhee Minor this time would burn completely, a pitiful little star ablaze for a few hours—and forever after dead. The very atmosphere would burn once the oxygen released from burning vegetation made that possible. Martians and Earthmen and Ootlandahs, every living soul on the planetoid would be doomed—Queel's people even more swiftly than the others, for theirs was that same highly inflammable lifestuff so characteristic of this world.

All this sped through Blakston's mind in a moment, and it was as though it wound up a spring within him—a spring that snapped suddenly into furious action, as much out of his own control as though he were, for an instant, two individuals. He leaped suddenly at the smaller man, knocked the deadly proton gun from his hand, and in a paroxysm of fury clawed at the convict's airsuit as though he could rip the fabric apart with his bare hands. With the advantages of surprise and weight, he might have downed his antagonist, had not huge hands grappled him from behind, closed viciously around his chest, dragged him struggling and kicking from his prey. He was jerked backward, pinned against the counter by a huge fist. The smaller man picked up his proton gun and leveled it—death in his stare.

"Is most evil to kill man friend," piped a voice suddenly. "Not to be allowed, I regret."

The convicts whirled upon Queel, whom they had ignored thus far, probably in the belief that he was some outlandish plant. The giant, recovering himself, laughed harshly.

"Hell—it's nothing but a native. He can't hurt us."

But the ferret-faced man, his nerves lashed raw, squeezed the trigger of his weapon. A proton blast whirled hotly from the gun's muzzle—a barrage capable of powdering steel plate at close range. Queel disintegrated instantly. Yellow dust drifted, settled swiftly to the floor.

Almost indifferently, Blakston felt

himself being trussed to a ceiling post, his hands hastily tied together behind the rough timber. He wondered dully why they troubled to secure him instead of blasting him as they had Queel, but his mind refused to ponder the question. Instead a hundred irrelevant thoughts came to remind him of events long past, of the day he had met Queel, of the many favors they had done one another, of the strange but genuine comradeship which had grown between him and the native. So compelling were the memories evoked by the settling of that handful of yellow dust there on the thurkwood floor that he scarcely felt the convict's hands upon him.

A sense of strangulation, a dull thudding in his temples, the rattling suck of dead air in his throat, snatched him back to the present. The smaller man was gone, the giant even now leaving; he swore as he stumbled over a looth-shearer's crook that had fallen across the threshold during Blakston's scuffle with the other convict. Then he was gone, and Blakston faced the empty doorway, strangely blurred in his sight.

There was a mighty singing in his ears, and his breath was quick, furiously quick, but it brought him no air. And then he knew why. His tank cock had been turned, the precious oxygen shut off from his helmet. Impossible for his hands, bound behind him as they were, to reach that all-important little handle just over his right shoulder. Even the strength to struggle was fast ebbing away from him; he was rapidly sinking into a coma from which there would be no awakening. Only as velvet fingers of blackness closed about him did that agonized retching for breath cease.

HE CAME to his senses with a dull booming in his ears. His skull throbbed painfully, but there was air in his helmet and he gulped it in deep, gasping breaths. With returning memory came astonishment at finding himself alive.

He had been clumsily cut free; the cords still dangled from his wrists. Somebody had turned on his oxygen—the giant convict, perhaps? Instinctively Blakston glanced at his oxygen gauge. Less than an hour's supply was left him; small wonder they hadn't thought it worth while to snatch the almost-empty tank from him. An hour to live, to fight—or to die in.

His rate of breathing settled back to normal, but the hollow booming he had first heard on awakening grew louder. Suddenly he knew it for what it was—the ceremonial drums and tambourines of the Ootlandahs, used only in solemn, secret rites or in grave crises.

He stumbled to the doorway, almost tripped over the looth-shearer's crook. Hesitating just an instant, he snatched it up, then ran out to stare down the steep trail that led from the commissary down to the landing field. The sky was already gray with dusk, the sun out of sight, yet a reddish glow lighted the sky ahead, and, as if to confirm its dread message, black smoke smudged the forest skyline. Fire!

Dhee Minor's death warrant was written in that flare of crimson light. The men from Reinmuth had kindled the forest while passing through it on their way to their ship. Blakston watched with thudding heart as a gigantic flame was sucked up into the sky, crimson as blood. Beside it another forest giant caught, blazed into a glory of green fire that writhed in virescent streamers heavenward. In Blakston's helmet surged a growing roar as that fiery surf gained in strength and volume.

He forsook the path in order to circle the burning area. Through the soft darkness of the forest, already flickering with fantastic colored shadows, he ran. Emerging, he overlooked the well-cleared landing field, now starkly illuminated by the prismatic radiance of the blazing forest.

A ship lay there, lifeless and un-

guarded. The men from Reinmuth were nowhere visible, but farther along the forest fringe, outlined in red and green and purple of the flames, were perhaps a score of dancing, leaping Ootlandahs, tragic little clowns in motley of light and shadow. From them arose a faint hooting chorus, a thrumming of gourd drums which they beat above their heads with pipestem arms. Blakston started toward them, into the dark shadows directly ahead. Something brushed against his helmet.

A prehensile finger of flesh rose from the earth before him, a slender living rope that instantly whipped about his waist. A second questing tentacle almost wrenched the looth-shearer's crook from his hands. He lost his footing, screamed as the thing pulled him relentlessly into the blotch of blackness which he had mistaken for shadow.

The looth! He was being pulled under it, under that vast fleshy blanket where a million mouths waited—toothless mouths whose corrosive digestive juices could dissolve bone, gristle, rubber, metal and glass. Not a whole squadron of proton gunners could rescue him once he was under that suffocating mass.

His fingers tightened desperately upon the crook, found the switch and pressed it. A pale-blue electrical discharge appeared along the slender electrode. He swung it madly, lashing out against stubborn tentacles, scourging the senseless flesh of the creature with the one thing it feared and shrank from —a stinging but harmless high-tension current generated by a battery and induction coil in the handle of the crook.

Pseudopods fell away before the electrode, dropped him on the leafless stubble of ground over which the looth had fed. He lay there gasping, sobbing for breath, his chest a vast ache where the tentacle had coiled about him. It was fully a minute before he felt able to stand.

The looth had backed a few yards

away by then, as he could tell by an occasional upflung pseudopod limned against the fire's glare. The thumpings and the hootings of Ootlandahs seemed redoubled, and he realized that they were standing their ground, facing their traditional enemy at close quarters instead of fleeing from it as they were wont to do. But why, and under whose leadership, were the timid creatures defying the dreaded looth?

A HUMAN CRY whirled Blakston about. From the forest, from a point midway between him and the Ootlandahs, it came. And then he saw the men from Reinmuth again, trapped there at the flaming forest's edge by that deadly living blockade which lay between them and their ship—the looth. That was the purpose of the drumming and the hooting—to keep the great beast where it was, a wall of living flesh against which even proton guns were helpless. But how, marveled Blakston, had the Ootlandahs grasped the situation, understood the danger of letting the convicts reach their ship, and so promptly acted to prevent it? The looth had been providentially near, but only genius had turned it to this purpose, only courage defeated the traditional terror all Ootlandahs had for the beasts.

Driven by fire behind, the convicts were running toward Blakston, intending to circle the looth and so reach the landing field. For a moment Blakston thought of intercepting them—and being blasted to death for his pains. He had no weapons—the crook was useless against proton guns. And once past the looth and in their ship, the convicts could set a dozen fires all over the planetoid.

They were still fifty yards away, sprawling and stumbling over brush and deadwood with their burdens of food and oxygen. Could he, wondered Blakston, reach the other "end" of the looth in time to join the Ootlandahs in forcing the ungainly beast back and keep it blocking the convicts' path?

He sprang forward, brandishing the crook as professional wool shearers did, opening a gap amid those questing tentacles. In one six-foot jump he gained the looth's back and scrambled away from the animal's side. The pseudopods could reach only a few feet back, forming as they did a fringe about the huge, squat body. Paradoxically, he was safer here than on the ground.

The looth's wool, prized in commerce, was thick and resilient underfoot, a carpet over a firm floor of flesh. He ran swiftly over it, toward the squealing Ootlandahs, who for all their noise were now slowly falling back before the looth's stolid advance. And every foot of that retreat in turn shortened the distance that lay between the convicts and their ship.

But they, hampered by oxygen flasks and the burden net, made hard going of it through the dense underbrush. Blakston chuckled madly and plunged on. The looth, he observed, was no less than a hundred yards long and fifty wide—a little over an acre in size. It surged forward suddenly as a gust of wind blew the hot breath of the fire upon it. The Ootlandahs, who had been standing in a clear swath of ground that was the feeding trail of the beast, turned and fled.

Blakston cursed them, and, having reached the "end" of the beast, laid about him with the charged crook. Tentacles writhed and disappeared before it. He applied the electrode directly to the looth's back. Sparks snarled through the thick wool to the flesh beneath. The looth quivered, jerked blindly back from the stinging pain, reluctantly retreated to again bar the convicts' path. Blakston felt a thrill of savage satisfaction. Now let the murderers try to escape!

The smaller convict dropped his burden, ran back through the scrubby

growth a little way, a grotesque gnome in the fantastic firelight. He stopped, rested his proton gun in a tree crotch for better aim. The narrow beam sheared past Blakston, followed an instant later by its characteristic miniature thunderclap. He laughed in reckless defiance, goaded the looth even more furiously. Small chance the man had of hitting him at this distance!

That was apparently the belief of the gunman, also, for his tactics changed abruptly. The proton beam crackled again, but this time its narrow streak of electrical flame seared a narrow welt across the looth's back. The huge beast shuddered, humped itself with a quick, convulsive movement, a sudden twitch like that of a horse's flank, but a thousandfold greater. Blakston felt as though the ground had reached up to hit his chin. He felt himself flying through space, falling, and tried desperately to twist in midair, to land without damaging his precious helmet.

HE STRUCK unyielding ground hard enough to knock every bit of breath from him, and lay half stunned for a time. His crook was gone, lost in that wild flight, and if the looth were to come upon him he would be in a bad case. On the heels of that thought he saw it, a wall of undulating tentacles, creeping down upon him in that inexorable way it had. He got unsteadily to his feet.

"Am most grateful man friend is living," said a reedy voice behind him. He whirled in astonishment. In the light of the forest fire, Queel stood there, whiskers aquiver—and in one flipper of a hand he held the precious crook.

"Ability to hasten life cycle at will responsible for my continued existence," explained the native. "When evil character attempt murder, self beat him to it. After departure of criminals was just in time to save friend Blakston by opening helmet cock."

Blakston nodded gratefully, a lump in his throat. He could guess what it had cost Queel to turn that stiff little handle with his soft, flipperlike hands. Nor was it the first time he had heard that the Ootlandahs could hasten their demise at will when danger threatened. In times of famine, whole tribes often elected to stay in the nuclear, or egg, stage for long periods—so many little beanlike pods lying inert in the yellow dust of their dissolution—only to spring magically to life at some later time. But against fire even this strange ability could not protect them, for the eggs would explode like any other living tissue on Dhee Minor.

It was Queel, Blakston realized, who had gathered the Ootlandahs and conceived the amazing idea of blocking the convicts' path by driving the looth between them and their ship. The little native had acted with marvelous courage and incredible quickness, reaching Heaven knew what heights of rhetoric to induce his timid fellows to face the tentacled horror.

"Many thanks for your kindly aid," continued Queel sadly. "But is now common sense for you to save yourself while possible. My people have run away. Plot to use looth can no longer be used. Evil men's ship lies there, offering you swift escape from world that is soon to die. Take it quickly, man friend."

Blakston stared at him thoughtfully. The Ootlandah's suggestion, oddly enough, aroused nothing but horror in his mind—horror at a people's acceptance of extinction, as voiced by Queel. It seemed to him that the little native was watching him closely, questioningly. And yet, what he said was true. There lay the convicts' ship; Blakston could seal himself in it, take off safely and reach some neighboring space post. There was no longer any need for him, at least, to share the death of Dhee Minor. And if he took off, the convicts would be irrevocably trapped, un-

able to set other fires on the planetoid. A part of Dhee Minor at least might be spared the flames.

The fire was, of course, spreading fiercely. Vegetation burned white and green and red and violet. Somewhere in the forest a chan-chan tree burst explosively, hurled aloft balls of crimson flame like an incredibly huge Roman candle. Above the general conflagration a feeble blue flicker of light hovered—the hydrogen sulphide of Dhee Minor's atmosphere burning in the surplus of oxygen released by blazing plants.

"I'm staying," said Blakston curtly, belying another and larger lump that had come into his throat. Leave now, desert this plucky little Ootlandah, he could not. "How about that plot you were talking about?"

Queel's whiskers quivered with delight. "Is mere hopeful idea. Looth leaves dead trail no fire can cross. What if looth were driven around fire and cut it off from rest of world?"

It was, Blakston realized instantly, just possible that the scheme might work. The looth, feeding as it went, left a fifty-yard-wide swath of cleared ground in its wake. Directly behind the forest rose the equatorial mountain range, a barren backbone of rock which twice before in the history of the planetoid had acted as a firebreak. On this side the fire was already isolated by that hundred-and-fifty-foot gap the looth had left behind. On the other it would leap from the patch of forest to thick scrub brush and bramble thickets, and from there everywhere—unless the looth could be persuaded to devour that tangled growth which was the next link in the chain of disaster. But could the beast be driven that way, against the heat? Could a single man with a looth-shearer's crook, succeed where the drumming, hooting Ootlandahs had failed?

BLAKSTON gave Queel his instructions. The native padded off and Blakston advanced upon the fringed bulk of looth, switching on the pale glow of the crook as he approached.

Again he whipped writhing tentacles aside, again leaped to the thing's broad back. The outlaws were not in sight. Probably they were trying another flanking movement through the brush, which must be getting pretty hot by now. But the growing fury of the fire made his own task harder. The looth moved slowly under the electrical prodding of the crook. Blakston gauged direction carefully and urged on that vast, stubborn bulk of eyeless flesh by running here and there to apply the stinging current to best effect.

The red glare of strontium compounds, the green of barium, the violet of potassium, the rarer white of magnesium, cast a weird, striated light over the familiar landscape, a pyrotechnical display of ghastly beauty, fed by living tissue of leaf and branch—and perhaps by more animate forms of life. Over a mile-long front flame raged. Blakston estimated its advance and anxiously compared its speed with that of the looth. The conclusion he reached was alarming. He cut in a heavier current on the crook, knowing that the batteries would drain more quickly. But hotter sparks had the desired effect. The looth quickened its pace, leaving behind it a broad swath of denuded ground upon which everything combustible had been consumed—feeding as it went through sheer inability to stop feeding!

Chance might, of course, defeat him after all. A bursting chan-chan fruit thrown too far, a stray spark or blown straw, might carry the conflagration abroad. The outlaws themselves were still the deadliest menace of all. If they broke through Queel's cordon—if Queel *had* a cordon—and reached their ship, Dhee Minor would be ablaze in a dozen

spots within the hour, on both sides of the equatorial range.

Two moving spots of flame caught Blakston's eyes, and resolved themselves into two men running from the forest. Each of the outlaws carried a blazing brand as defense against the looth. Blakston bit his lip. He had not considered the simple, daring strategy of fire—fire before which looth and Ootlandah alike must give way. As he watched, the bigger convict thrust flame against the outflung tentacles of Blakston's huge mount. The looth shuddered and retreated. Both convicts came on, gaining ground at each step as the beast fell back before their singeing brands. A ripple of pain went through it, hurling Blakston to his knees. If the looth itself caught fire, he knew, all hope was gone; fleeing from the flame death that rode its flesh, it would spread disaster irrevocably.

But its own sense of pain, and the less inflammable covering of thick wool that guarded its flesh, prevented that. When Blakston had regained his feet the convicts were racing for their ship across the barren landing field. Nothing there, at least, for their torches to set alight, Blakston knew. Now it was up to Queel and his people to stop the outlaws, if they could, while he kept to his all-important task of circling the fire with his monstrous mount.

It grew increasingly stubborn, and he was forced to turn on more and more current in order to turn the recalcitrant beast into the sweep of the fire and goad it at last up to the very fringe of rocks, which it steadfastly refused to mount. But it had served its purpose. He raced to the side of the looth, swung the crook to clear its upflung pseudopods so that he might jump to the ground.

The tentacles did not waver. One of them seized the crook and almost yanked him off his feet. Helpless, he realized that the batteries in the thing had been exhausted. He was a prisoner on the looth's back! To try to jump through that living fringe of tentacles was tantamount to suicide.

ON THE landing field he spied two running figures armed with brands, encircled by a thin and futile line of Ootlandahs. A few threw gourds and stones. Twice a whirling *kfee*—the knife discus, made of native flint, which the Ootlandahs used to cut fruit down out of high trees—flashed close to the fleeing men. But constantly the natives retreated before those menacing brands. Faint thunderclaps of an occasional proton blast reached Blakston's ears. He desperately wanted to go to Queel's aid.

In that desperation he ran to the side of the looth nearest the fire, which was now burning down to the very edge of the denuded area. On this side the heat was greatest, and the animal was sluggishly drawing away from it. Its tentacles were erect, bent inward away from the withering heat. For a moment he almost gave up hope of breaking through that sentient wall, yet he realized that here was his only chance. The heat of the fire was his ally.

He crouched, tensely watching for a gap to open in the fringe of writhing tentacles. He jumped, the soft, yielding wool underfoot making his leap a clumsy one. The gap began to close, and he felt the hairy touch of pseudopods as he dropped.

He landed on his feet, stumbled, but rolled over and over out of the looth's range. A blazing limb crashed not a foot from his head. Smoking fronds fell on his legs. He brushed them off and sprang to his feet, and began running toward the landing field at a ridiculous but swift gallop. Had the convicts worn such a flexible airsuit as he had on, he thought grimly, they would long ago have reached the ship. But their heavy, stiff, pressure-proof space armor made such a gait impossible to them.

He was startled to see them scarcely

a hundred yards from the vessel. The Ootlandahs were being driven back constantly; they delayed the convicts little, if at all. One native, boldly approaching the men to hurl his *kfee,* doubled over in pain as the bigger man thrust the brand against his body. The Ootlandah, hooting mournfully, became a briefly burning column of yellow flame.

Blakston put all his heart into a last burst of speed, fury seething in his veins. Let them fight man! Let them meet somebody who wasn't afraid of fire—or of their guns!

The smaller man saw him coming, jerked the proton gun up. Blakston heard its thunder, ducked, flung himself into a tackle that hurled the convict to the ground. But something tackled Blakston in turn. He felt himself lifted as the looth had lifted him, and turned around in midair to face his assailant. It was the other outlaw, the giant, still carrying in one huge fist the net with its tremendous load, and the torch with which he had fought past the looth. But with the other hand he held Blakston, shook him as a tiger shakes a hare.

The ferret-faced man struggled erect. The big outlaw dropped the net and reached for Blakston's airhose. Blakston smashed his fists numb against the man's space armor, but he felt the end to be near, and inevitable. One rip of those strong fingers would tear the hose; instead of oxygen, the poisonous atmosphere would seep into his helmet.

A *kfee* hurtled before his face. The spinning blade slit through the tough, flexible canvas joint between the convict's helmet and shoulder plate, but drew no blood. With the hand that still held the torch, instead of ripping Blakston's airhose, the man tore the flint disk free, mouthing curses.

Incredulously Blakston saw a puff of sullen blue flame blossom out over the rent in the canvas. Instantly a column of azure fire flared between him and the convict. The torch had set Dhee's atmosphere afire where oxygen streamed from the man's spacesuit!

Blakston easily squirmed free as the other made futile, frantic efforts to beat out the flames. The canvas charred, the rent grew larger, and the column of fire thicker. Behind the helmet plate the convict's face worked in helpless terror.

THE OTHER convict turned briefly in his flight, saw what had happened, but sped on alone. With a bellow of pain and rage that faintly reached Blakston's ears, the giant lumbered after him, a living torch. The other turned, sent a proton blast stabbing wildly toward his late companion. Blakston also found his legs and joined in pursuing the smaller man, who had almost reached the ship. Beside the open air-lock port he paused to hurl his blazing torch full at Blakston.

It struck him on the knee, splintered into burning fragments that threatened

to fire his suit. He brushed them off hastily, but that moment's delay wrought bitter havoc. The convict slipped into the air lock, and the ponderous door now swung slowly to behind him. It was all over, Blakston thought grimly. The man would take off, drop a blazing rocket stream into some other forest or brush, and Dhee Minor would blaze into a tiny starlet for a few hours and be no more.

But Blakston had forgotten the giant, who had never paused in that tortured, lumbering run of his, and was close to the ship. He hurled his flaming body at the air-lock port, gripped the thick stellite rim, and held on for life, as though he knew that only by getting into the ship, away from the planetoid's inflammable atmosphere could he cheat death. Blakston could hear him scream with pain as fire ate inexorably toward his flesh. But he held on doggedly. The other outlaw, inside the air lock, could not secure the port to its pressure-tight seat. Nor could he enter the ship proper, Blakston knew, for the inner and outer air-lock ports were interlocked, and only one could be opened at a time. It was a curious, fatal deadlock.

The man inside ended it. Suddenly he let the port swing wide, which threw the straining giant off balance. In the air lock stood the smaller convict, proton gun ready. Its thunder blasted once, twice—

Blakston's heart was pounding madly. All his being focused upon a rock lying providentially before him. He picked it up, aimed to a nicety, and let fly. There was a crunch as it struck a fragile helmet. The ferret-faced man fell out of the air lock into the giant's arms, and the bundle of oxygen flasks tumbled out with him.

Reason had departed the tortured body of the big man. He battered the other with maniacal fury. Blue flame roared between them, augmented by oxygen pouring from the smaller man's shattered helmet. And at last the giant tossed him aside, a limp, broken, blazing puppet.

Blakston felt sick. He saw that the giant was blind now, and felt a thrill almost of pity as the man lurched past the ship. The gross vitality in that huge frame carried him a dozen steps farther. Then his knees buckled and he pitched forward, slowly, like a felled tree.

Dimly Blakston was aware of a circle of Ootlandahs who had watched the end of things like so many silent ghosts. Dimly he knew there was something wrong with him, but his head was spinning madly, and even trying to think made it worse.

The oxy-cylinders flickered before his sight, seemed to pile themselves into fantastic, dwindling pyramids. And then he knew what was wrong. His tank was empty. He needed oxygen and he needed it quick. He staggered toward the tanks, slowly sank to his knees and crawled the rest of the way.

They were enormously heavy, and he could not lift them. With immense, clumsy fingers he strove to undo the buckles that held them together. Again there was a ringing in his ears and things were going dark.

What had he told the outlaws? That men sometimes staggered up to the space post so weak from lack of oxygen he had to attach flasks for them. And now he was that way. He had twenty flasks of oxygen, but not enough strength in his fingers to untie them and hook one to his airhose. It was almost funny, and the funniest thing was that he was too tired to care much. The buckles slipped out of his hands, and he knew there was no time to try again. Because even now he was sinking into that soft darkness where nothing mattered.

IT WAS daylight and Queel was bending over him where he lay on the landing field. The Ootlandah hissed

gently as Blakston opened his eyes.

"Must apologize for clumsiness of useless digits," said Queel, which was an overstatement because he had none. "Not intended for making tank connections, which mastered only after much trying."

Blakston grinned up at him. So Queel had saved him again. Good old Queel—

"Fire devil is dead," continued the Ootlandah. "For that, and because man friend is okey dokey, gratitude is unbounded."

Blakston nodded, satisfied. But Queel's eyes, green-rimmed and unutterably mournful, contracted suddenly.

"Regret imminent passing which—Look out!"

The native tensed, trembled violently, and sneezed himself asunder. Pale dust drifted where he had stood a moment before, and Blakston watched, fascinated, for that miracle of mushroom growth to occur. Seconds ticked past. From the mound of yellow dust a particle sprang up, danced madly as it grew with explosive violence.

Blakston sighed. His resignation from Space Post 291 was on file at I. R. C. C. headquarters. It was eight years old now, because he'd sent it in after his first month here, "to take effect one month from date." He saw now that it wouldn't do. He didn't want to leave Dhee Minor. Lonely? Sure. Smells? He was used to them. Friends? Enough—and not all of them wore air helmets.

Queel stood before him. Queel stood erect and quivering, and said, by rote: "Queel the younger salutes you."

And Blakston merely grunted. For a grunt, he knew, meant a lot between the two of them.

SHAWN'S SWORD

By LEE GREGOR

SHAWN'S SWORD

Shawn was a big, stupid ox—and all his brains were in his fingers. He dreamed of slaying dragons and being a knight—in a spaceship!

By Lee Gregor

Illustrated by Orban

"Nothung, Nothung—I name so this sword,
Nothung, Nothung—Notable steel—"

THE sullen red glow of the fire flickered over the man's face as he beat violently on the anvil in time with his lusty singing. He was big, in height and in girth, and his face was ruddy with a mighty joy. Sparks pounded from the anvil; the incandescent strip of metal lying there gradually assumed form. It was a sword, straight, double-edged, and of diamond-hard metal.

Big shadows crawled blackly over the walls of the darkened chamber. Machines stationed around the room assumed grotesque form in the flickering light. It was curious that with the wealth of metal-working machinery present, the man should choose to forge the sword—archaic weapon—by brawn of shoulder and arm.

He roared on, making the surrounding shadows quiver with the song of the ancient hero, Siegfried. More fervent it grew, combating the ear-shattering clamor of the hammer.

"What the devil's all the noise about?" A rough voice broke into his mood. "I could hear you at the other end of the asteroid." The intruder, squat, bulky, unshaven, advanced into the room.

"What d'ya have there!" He reached out for the strip of metal in the singer's hand.

"N-no—" Arthur Shawn shrank back. His big, rotund figure seemed to collapse on itself, and the light seeped out of his eyes. "It's . . . nothing." His face seemed childlike in its fear as he battled with a devasting slowness of speech.

"A sword!" the other shouted. "King Arthur's making a sword!" He roared in laughter. "Here y'are, King Arthur, some more books for you. They just came in the mail torp. Maybe ya can make yourself a white horse out of them!"

He dropped a heavy package on the floor and staggered laughingly out of the room. Far down the hall—at the top of his voice—hilariously he roared: "King Arthur's making a sword! A sword!" It echoed faintly in the room, where the fire on the crude furnace wavered dimly.

Arthur Shawn's eyes reflected hurt. Slowly he turned and, shoulders stooped as though he feared his own six-and-a-half foot height, he shuffled out of the room.

The corridor was small for his huge bulk. But now, away from the inspiration of the forge and song, his size seemed more round and soft than muscular and strong. His face, relapsed into its normal rotundity, was expressionless

and empty. Only his eyes—the lines around them showed pain, as of a child rebuked for doing something it thought was good.

His room was a cubicle that seemed to shrink as he entered. A bed at one corner, a desk opposite, and around the walls shelves of books.

Shawn's eyes lit vaguely as he stood there scanning the books. With eager expression he placed the package on the desk and cut it open.

"Ah!" he breathed in delight as the titles spread before him. Curious titles they were for an asteroid miner. Likewise were the hundrds of books that lined the walls. Children's books of adventure, mostly very old—about medieval knights, King Arthur, Robin Hood, Don Quixote. Recordings and the scores of romantic operas: "Die Walküre," "Siegfried." Their spirit breathed life into Shawn's frame.

He was lonely here on the asteroid. It was hard for him to talk to people—some misconnection in his brain made it necessary to fight over each word. Withdrawing into himself, he kept to his room and his books, only venturing forth for his daily work of mining cosmolite crystals.

Like most stutterers, when he sang, he had no trouble with his voice. At first he had tried singing, but the men's ridicule stopped him. He never told them he had once tried to be an opera singer. That would have made things intolerable.

He never had become a singer. His figure was ridiculous, in the first place, and, too, he wasn't very bright. He never seemed to be able to cope with situations the way other people did. His mind worked so slowly, and his halting speech accentuated it.

Escape—his life was a continuous escape from reality. Off to the asteroids to be far from civilization; persecuted by the men there for his lack of wit and his strange ideas; then escaping into children's books to wallow in the romantic and mighty deeds of the valorous men of old.

Those were men! Galloping on their white steeds, battling, swinging their mighty swords—there was always a sword. *Excalibur—Nothung—*

Why wasn't he like them? Gradually he became so, in the closed world of his mind. In his own fancies he did all those wonderful things. In his mind he rode as an armored knight, steel-clad on a wonderful horse, until that alone was real to him and everything else was trivial, passively to be borne for the sake of his dream-fantasies. They *were* only fantasies, but—why have them so? Why not make them real?

A SWORD—he must have a sword against the ridicule of men. A sword to make himself invincible.

He was clever at making things. Sometimes he wondered if part of his brains—he had so little brains—were not in his hands. For they, big and clumsy though they seemed, had a very curious skill at doing delicate work.

He would make a sword, a very special sword. The men would marvel at its beauty and prowess.

Shawn thrilled as he sat there reading the new books. Such wonders they told. If he could only live thus. Perhaps he could make enough money, strike a rich pocket of crystals.

He stood up, face set in as close an approximation of determination as its soft lines would allow. His shoulders drew back. He'd show them.

The clang of the bell announced the next work shift. Abruptly his shoulders slumped. He was back in his own skin, his dream broken. Through the door he slunk, and down the corridor. Shouts of laughter greeted him in the big room that led to the air locks.

"Where's your sword, King Arthur? When you rescue a maiden in distress, O King, don't forget to get me her visi-

phone number!" They crowded about him derisively.

The incoming shift surged on, shedding spacesuits.

"Listen to this!" The loud-mouthed one who had caught Shawn at the forge told them the hilarious news. "King Arthur's making a sword! When he's finished he's going out to fight dragons on a white horse—with a special spacesuit for the horse!"

The chamber resounded with laughter.

Shawn seemed to shrivel. "G-go away," he mumbled inaudibly, and pushed through the mob to where his spacesuit hung. His eyes were moistly bright.

Outside was silence. Shawn felt better there, with the clean, searing rays of the distant sun etching the jagged landscape in vivid outline.

He allowed his driver units to waft him away to his digging site. The lack of gravity exhilarated, and a momentary extra touch of oxygen cleared the trouble from his mind. It was pleasant, floating out there alone. From the small height he could see nearly a tenth of the total area of the asteroid. The view was fantastically beautiful.

Shawn spied the cairn that marked his site of operation, and settled down beside it into the well-worked cavity. The electric chisel in his hand vibrated gently, until a shower of reflected light revealed the presence of a cosmolite crystal.

As he worked there silently in the vacuum, Shawn wished that he had enough brains to understand what cosmolite crystals were used for. All he knew was that they were essential in atomic generators, power broadcasters, and beam radiophones. They had curious properties of focusing electromagnetic vibrations, whatever they were.

They were found only on those asteroids which had been part of the center of the original planet; very brittle, their mining was a tricky job.

It was very difficult for Shawn to think and work at the same time, so presently he gave up the one and merely worked.

Inevitably, the signal came through for the end of the shift. He stayed out some minutes longer than usual this time. He did not want to encounter the crowd in the air-lock room. There were a few there still, when he arrived, but he pushed stolidly through to his own chamber, where he could be alone and could escape into his phantom life.

Exhausted, he ate and then slept for some hours. Day and night mattered little to these men, where the sun rode on the hands of a chronometer.

The handle of his sword was a beauty. He worked on it the next day for several hours. It was carved of a ruddy alloy that seemed to glow with an inner fire and etched with intricate designs. There was a book, a thick, heavy volume, that he pored over constantly while assembling the haft. A sword maker of old would have wondered at some of the things he did.

Another work period, while he silently endured the jests of the men.

THEN the final working of the blade. Behind locked doors, he lived in the character of a hero, while the blade was pounded and polished to a mirror-finish and a razor-sharp edge. The polishing was tedious, for the metal, after undergoing his treatment, was incredibly tough. Shawn disdained the use of machines. This sword must be done entirely by hand, and it took more than one work period before—

"How's the sword getting along, King Arthur?" The usual cry greeted Shawn as he entered the air-lock room to watch the coming of the small police ship that patrolled the lanes among the asteroids.

"It's finished." He spoke with a mixture of pride and shyness. The clang of the landing craft vibrated through the

buildings, and metallic rattles sounded as the air-lock connection was made.

"W-wait." He turned and ran back to his room, followed by laughter that didn't seem to matter so much, now.

When he returned, the air lock had been opened, and the five patrolmen were emerging, filling the room with their clamorous greeting.

"Look! King Arthur has a sword!" His name was known throughout the asteroid belt.

"Let's see it. Is he strong enough to use it?" This as Shawn, with the expression of a child exhibiting a toy, held it up.

"Here . let me see it."

"No!" Shawn drew it back. Their hands should not defile his metal. It was a wonderful sword. Like *Excalibur,* which had made King Arthur invincible, or *Nothung,* with which Siegfried had defied Woton, king of the gods.

A current flowing from it seemed tangible, giving him strength to defy them.

"I won't break it," the man growled, advancing. "Let me have it!"

"No!" Shawn's voice rose operatically, and with a spasmodic motion he rapped the man's unkempt skull smartly with the flat of the blade.

The room howled at the miner's discomfiture.

"It's a magic sword," one of the police explained gleefully, "he can't be beaten with it!"

"If you want to kill dragons," another patrolman continued, "why don't you go to Ganymede? The dragons there are even uglier than Carlos!"

Shawn's face shone. Was it really courage the weapon gave him? Was that strange recklessness, that feeling of unconquerable might, courage? He had never felt like this before.

So hard to express himself in speech. Words struggled to escape, but his throat clogged, throttling the sentences. Sweat leaped out on his face as he struggled to say the thought that had come to him.

Sing it!—his mind whispered. Singing frees your tongue! What if it is melodramatic! Drama is the life you seek!

From his throat broke forth great volume of tone. Uncertain quality, perhaps, but the spirit behind it— The incongruous spectacle of this living inferiority complex uttering such vibrant song struck the men motionless. Across the floor to the air lock he swung fiercely. No one moved to stop him.

"I go, then, to Ganymede; dragons will I slay! For with the sword, *Nothung,* giving strength to my arm, I defy the world to inflict on me harm!"

The last note, loud, high, sustained, broke off suddenly with the slam of the air lock. Simultaneously the men awoke from their astonishment, and in a turbulent wave crossed the room to pound vainly on the metal.

THE other half of the connection was released, the valve shut, and with a bound Shawn was at the controls. The exultant spirit still drove him, and with but a glance at the simple controls he flipped on the antigravity—driving the ship straight up.

He had never piloted a ship before in his life. Far from the asteroid, out in the emptiness of space, fears began to creep back into his brain. But a hand on the sword hilt reassured.

Was he not invincible? Was not his destiny to do things heroically, as men did in books and opera? Ah, if life could be as it was there! His eyes gleamed as he whirled about, listening to the swish of an imaginary crimson-lined cape, and the click of sword against sword.

Ganymede—the man had said there were dragons to be killed. There he would go. He exalted with the thought

of the great deeds he would do there. Since the mathematics of course-plotting were too complex for any ordinary human mind anyway, the machines took care of that, and the trip, guided by the humming, clicking course plotter, was spent in dreams as thin and unsubstantial as the space outside the hull.

Ganymede spun below after a week. The orbit the plotter put the craft in gave him a distinct, kaleidoscopic view of many-colored vegetation. A small town, domed for higher-pressure air, came into view. Shawn ignored it. Where was the land of the dragons? There, perhaps, where such foliage as Earth never knew reared up for hundrds of feet.

How to land? The automatic machinery, so simple when it came to traveling through space itself, gave no clue. His hands, clever and swift with most operations, were clumsy with the few levers and switches he now had to manipulate.

The ship lurched downward. Too fast. The forward motion then decreased too rapidly. He cut off the antigravity. The ship dropped like a plummet. Frantically he shot on full antigravity: upward surged the vessel, the sudden motion sending him into the control panel. His arm depressed the forward power lever, while the nose of the ship fell abruptly.

Panic-stricken, his mind ceased operation and fear moved his suddenly paralyzed fingers. Antigravity worked against motive power, and staggeringly the ship careened downward. Then an abrupt deceleration, a flash of tangled branches and spiny leaves, and a jarring stop, while mud spattered in sheets and gobs from the swamp.

After some minutes Shawn lifted himself from his uncomfortable position draped over the control board. His nerves quivered, and his hands shook. He felt cold, and an uncontrollable shiver passed over him. To be back in his little room, with his wonderful books — Then his hand touched his sword, and he recalled why he was here.

Everything was ready. He had prepared a pack with necessaries, and the respirator to boost the tenuous atmosphere. No need to wait longer. Shouldering one and adjusting the other, he was through the air lock in another moment.

The ground was soft and muggy, sucking him in almost to the top of his boots. With difficulty he advanced, regretting momentarily his decision to leave the antigravity lifter behind. But no—a hero must endure hardships without the softening accouterments of civilization.

The marsh continued for a short distance, and then the ground rose. It became dryer, and the character of the vegetation changed from bushy, sharp-spined plants to long, ropy, brilliant-hued growths. Shawn advanced cautiously, watching for signs of alien motion.

Something small on the ground seemed to change its shape, or was that a trick of vision! A bright streak of color shot out from underfoot and disappeared in the brush. Shawn thrilled with alarm and recoiled a yard.

Breath came quickly, pulse beat fast. Stooping slightly, eyes darting from side to side, he continued slowly. The foliage thinned out; a bare stretch of land was ahead.

Then from one side—Shawn was paralyzed as by a bolt of lightning—a shrill, sirenlike shriek wavered and wailed. A series of heavy crashes sounded, and then Shawn saw it—vaguely, through the branches. Big, reptilelike, with eyes of yellow and hide composed of millions of tiny scales that scintillated and sparkled in the sunlight. Like a coat of jewels it was, glimmering with all the colors of the rainbow in incredible mixture.

Shawn was running suddenly, without volition.

WHY are you running, Shawn? There's your dragon following you! You mustn't run, Shawn; you're a hero! Put your hand on that sword. You are invincible with that sword. Why are you running away? Stop, turn, face the monster and kill him! There he is—right on top of you!

Shawn looked back—a confused mass of colors—right behind—closer—above!

A sudden flash of incandescence—a wave of heat. Then Shawn's foot caught on a root and the ground flew up to meet him.

A man was standing over him. At first he seemed to be far away and in a poor light, but presently he was close and more visible. The stranger was a little past middle age, but was healthy and robust, alert. He was dressed in the rugged clothes of a planetary pioneer.

His hand held a still-warm neutron blaster. On his face was a puzzled expression.

"Where did you come from?" he asked, helping Shawn to his feet. "And why are you carrying that? A sword is no sort of weapon for this place."

Shawn spoke slowly, absolute misery lined his face. "I . I made the sword. I was mining in the Belt, and I came here to kill a dragon. The sword makes me invincible"—he choked a little —"but I keep forgetting."

"Oh, I see"—dubiously. The stranger closely scanned Shawn's countenance, and his pursed lips showed the revolving of inner thoughts. "My name is Briggs, John Briggs," he proffered his hand, which Shawn took loosely. "I own this land and raise Rainbow Dragons. People pay a lot for their skins."

The two circled the prone monster that lay among smashed bushes, noticing with satisfaction the gaping, smoking wreck of what had been the head.

"I'll come back later," Briggs moved on, following the rising ground, "and get its skin. This one, unfortunately, was not to have been killed for a while. We try to conserve them; they don't breed very fast." He motioned vaguely ahead. "My house is up there. We should be having dinner soon."

He stopped abruptly, and his face darkened with the suddenness of a Venusian thunderstorm.

"Poachers!" he grated explosively. Pushing through a clump of bushes that obscured the vision to the right, Briggs came upon a mountainous heap of bare flesh that lay there in a swamp of gore. The spectacle of the skinless, bloody carcasses was nauseating, and already an army of little things was at work.

"One, two, three of my beasts killed." He studied the tracks. "They didn't go to the house. But there'll be more of my animals slaughtered."

"Poachers?" Shawn queried blankly.

"Yes! Gangs of them roam about, killing our animals and underselling our price. They don't have to stand the cost of raising them." Bitterly, "I think the police are fixed. They never seem to get here soon enough. I don't even bother to call them now." His hand tightened on his neutron blaster.

"We'll go up to the house and see if everything's all right. Then we'll find those rats and make them pay." Briggs' eyes belied his gray hair.

"Can you fight?" he asked suddenly.

"Yes!" Shawn brightened. "My sword—"

"No." Briggs was very impatient. "That's no good. Can you use a blaster?" He talked ferociously to himself, striding up the hill. "We'll finish them this time. We'll wipe them out so clean nobody'll ever dare come here again!"

REACHING the house, a low, sturdy metal structure, he punched at a button to the right of the entrance. A snap answered from within, and the door opened. The two crowded into the air

THE YELLOW HOARD

Prof. Archer S. Gray,
famous explorer, presented
each of his friends with
curious little clay bricks—the
receipt of which always led to murder.

Until—

The Avenger's friend received one—

Then the trail led to treasure—

Through a most baffling mystery.

It's a story of high adventure
which introduces Nellie, as
pretty as a Dresden doll, but
as tough and clever with
her hands as a top-notch
wrestler or boxer.

THE AVENGER

ON SALE SEPTEMBER 6th

10c A COPY

lock, closed the portal, and after the pressure had been raised by a hissing inflow of air, opened the inner panel.

"Hello, sweet," Briggs greeted the woman who stood expectantly within. "We have company. This fella's ship was wrecked down in the swamp. By the way," to Shawn, "I don't think I got your name."

Shawn's gaze jerked back from the path it had been following around the comfortably furnished room, lined with books, pictures, and other evidences of culturé incongruous to this frontier planet.

"Oh? Oh Shawn, Arthur Shawn."

"This is my wife, Shawn. You make yourself at home while I get things ready. I'll only be a minute."

Mrs. Briggs followed her husband out of the room at the invitation of a beckoning glance.

"Who is he?" she asked when they were out of earshot.

"You know as much as I do about him. I found him being chased by a Rainbow down in the bush. He looks a bit . . . a bit weak, here." He motioned significantly. "But harmless."

"It's a pity."

"Yes, yes"—abstractedly. "But we have real trouble on our hands. The poachers got three more out of the herd. If I can get Shawn to help, we'll wipe them out. No waiting for the patrol this time. I'll let him have the small blaster and I'll take the big semiportable. Then with the bombs I made—"

"Take care, John!"

"Don't worry—but what's that?" Noise came from the other room.

Mrs. Briggs started—then relief. "It's the phonograph. Why—he's playing 'Die Walküre'!"

Briggs nodded. "He would. You noticed his sword? He has an idea that he's one of the old heroes. Siegmund killing dragons, you know."

He had unlocked a heavily armored choset, and now he pulled out of it the big blaster and several small cylinders, some of explosives and some of gas.

"Oh, Lord! He sings too!"

Together with the recording rose Shawn's voice, slightly off pitch. *"Whose hearth this may be, here I must rest me."* Answered by the gruff tones of the basses, followed sweetly by the violins.

The raucous door buzzer broke in, sharply. Briggs laid down his armload and snapped on the vision plate.

"So! A patrolman. You wouldn't think one could possibly come around when you needed him." He worked the door control.

Through this Shawn stood ecstatically following the music.

The policeman was in haste. "I'm looking for—" His eyes, sweeping the room, came to rest on Shawn's oblivious figure. "There you are!" Angrily, "You're under arrest!"

"What's up?" Briggs queried, none too pleasantly.

"This man's under arrest for stealing a patrol ship!"

Briggs exploded with laughter. "Stealing a patrol ship! Why didn't you get police protection!"

The policeman flushed. "Stay out of this. He's the guy we want. That sword, and that stupid face—"

"Stupid?" Shawn suddenly noticed what was going on, and his eyes dilated in fear as he saw the patrolman.

"Yes, you. You're coming with me, stupe."

"No. I won't let you take me."

"So, resisting arrest, too?"

"Watch out!" Warningly. Shawn had his sword unsheathed, and brandished it clumsily.

"Stop that! You'll hurt somebody!" the policeman was alarmed as Shawn

waved the sword wildly. He drew a gun.

"Don't . don't!" Shawn thrilled with insane fear as the gun appeared in the man's hand. A mad, thoughtless sort of courage activated his arm—not his mind. The flat of the sword glanced off the patrolman's head, stunning him, while the edge, slicing a flap in his scalp, stained his hair red.

"Don't come near me!" Frantic, Shawn snatched up his respirator and retreated to the air lock, while the wounded man sank to the floor with Briggs springing to his aid.

THE DOOR opened and shut. Hiss of air, outer door open, and Shawn stumbled, ran—mind blankly afraid. Had he killed the policeman? The question was driven into him by the pounding of his heart. He must escape! All his life the one thing. Escape. Escape from reality, escape now from the law.

Branches tore at him and creepers tried to twine about him as he ran blindly down the hill. A ravine was suddenly across his path. A stone rolled under his foot, and he fell, gently under the mild gravity, to the bottom of the precipitous slope.

Bruised, he dared not wait. On he must go, far from here, where he could find complete solitude. People were dizzying to him, nauseating. Even the nice old man and his wife. He had learned, after a long time, what that expression on people's faces meant. Even *they* thought he was crazy. And he wasn't—really. He ran on.

The ravine deepened as he scurried along it. The swamp, where the wrecked spaceship lay, was behind and to the left. He had left the house and gone down the hill at an angle other than that of his approach. The distant, tiny, but intensely brilliant sun was near setting. Jupiter raised a gibbous face over the opposite horizon.

An abrupt turn of the canyon plunged Shawn into deep shadow. The gloom that settled about rapidly approached the intensity of that within his mind. The overhanging shoulder of the cliff obscured vision from above. The space below deepened until it became cavelike. Wildly tumbled and massed rocks gave some protection.

Why not rest here? It would be hard to find him, hidden far back under the cliff.

Grateful for the opportunity, he sank down on a flat rock. The words of that old opera came to him, the one he had just been singing a while ago. *"Whose hearth this may be—"* Here was no hearth, and no storm raged without, but the situation was similar: a hero fleeing from vengeance, finding haven from danger. A glow of pleasure at the thought began to warm him. After all, he had defended himself with his sword. Perhaps he really was a hero, but always in trouble, like Siegmund: *"Peaceful may I not call me; Joyful would I had been. But Woeful—"*

Clamor outside startled him. Rough voices calling, shrill in the thin air.

"Here—set the packs here. We'll camp for the night. Hey! Douse the light. Do you want to be seen?"

Shawn quaked. From his position he could dimly see several figures, momentarily outlined by the flash of light. A scintillating iridescence sparkled from one of the packs, and Shawn knew they were the poachers. It was the stolen skins; it could be nothing else.

Farther back into the dark he shrank. If he were seen—his mind refused to follow the thought further. A fear-hounded, quivering mass of flesh with a sword stuck in the belt was what remained of the hero.

"Under the ledge!" the authoritative voice bawled. "As far back as you can go. We won't be seen."

To compress Shawn's bulk into as

little space as he attempted was impossible.

"Fine place. Like a cave. We'll have to remember this— Hey! Who's there?"

The darkness was cut by a knife of light.

"Come out of there—quick!" The heavy gun in the poacher's hand looked like a cannon to Shawn. In darkness, behind the searchlight, with respirator around his head, the man appeared monstrous and grotesque.

"My finger's nervous—come quick!"

Shawn tried to speak. Gurgles came from his paralyzed throat. From behind a rock he crawled, trembling.

"So! What the blazes are you doing here? Having a pitnic?"

"I . . I'm Arthur Shawn." The reply was ludicrously stammered.

"Pleastameetcha," the poacher rasped sarcastically. "Fellas, meet Mr. Shawn." His voice was broad and unpleasant. "Mr. Shawn was going hunting when we interrupted him—with a sword! What were ya hunting, Mr. Shawn—Rainbow Dragons!"

Shawn's face lit in innocent surprise. "Why, yes. How did you know?"

"Haw-w-w!" The bellowing laugh burst from the poacher, echoing weirdly along the canyon walls. "Just hunting dragons with a sword! Maybe it's a magic sword! Lemme see it."

"No." Shawn drew back. Always like this. Always laughter and ridicule at the sight of the sword. When it was the most wonderful sword in the universe. He had made it so. It was magical—almost.

"Pipe down!" one of the gang complained. "Do you want to be heard on the other end of the moon?"

"What's that noise down there?"—from above, unexpectedly.

The poachers whirled, diving for weapons and cover.

"The poachers! They're under the cliff!" Shawn knew the voice as he slunk back. Briggs and the policeman; they'd tracked him here.

SCRAMBLING sounds came from down the ravine. Briggs must be mad, to attack like this. Shawn must warn him. Briggs was a good man—even if he did think Shawn was crazy. Briggs didn't laugh at Shawn's ideas like others did. Shawn must help him.

He tried to shout. "Bri-i—" the noise was tiny and swallowed in his throat. His treacherous voice! Then, he had the idea. To sing! The way he could say what he wanted without the hellish clutchings in his throat.

"Briggs! John Briggs!" He opened his mouth and the notes came freely. "They're here, too many of them, go back!"

"Shut up!" A surprised and savage face turned to him, distorted with fury. From the gun held by the owner of the face spat a sizzling beam of incandescence that made the air reek with choking brown fumes. Behind the man, at the same time, another ray lashed the rock to furious heat, while splinters of stone exploded from it. The poacher's blast went wild.

Beams leaped back and forth, lighting the ravine with a flickering and flashing brilliance. Briggs and the patrolman were shooting aimlessly. A hit was impossible in the intermittent illumination from the succession of bolts. But the poachers could do no better: two tiny targets, somewhere down the ravine, lost in darkness, with the light shifting and confusing.

Shawn jerked and twitched with fear. The rock to his right flared and cracked suddenly, beginning to melt. A bomb of terrific power shattered deafeningly, but thrown short.

Activity among the poachers. Something being removed from a case. A squat, thick barrel on a heavy tripod: a semiportable blaster. Shawn knew its

work. The five-inch beam would scream down the canyon. Frightful energies powered it. Briggs would last in it for the veriest instant required for his body to be torn molecule from molecule, atom from atom.

And Briggs was a nice man. No one else had ever talked to Shawn as Briggs had. No one else had refrained from laughing at the sword in Shawn's belt.

And he remembered. The sword leaped out of the scabbard.

Was he mad? Defeat a gang of weaponed poachers with a sword?

But this sword was a very special one. Even the heroes of old had never seen a sword like this.

For an incredible instant the walls of the ravine were outlined with light that dazzled and seared with sheer intensity. Noise thundered back and forth, deafening even in that thin air. Wind shrieked; chips of rock flew madly as shrapnel.

Shawn felt himself thrown very violently against the rocks: and then, startlingly, everything was very silent, and he was flat on his back with Briggs flashing a light in his eyes.

Briggs' face reflected unmatched astonishment. In his hand he held Shawn's sword, unconsciously turning it over and over.

"Shawn, did I really see what I saw?" he said. "I mean . . . did this sword really . . . how?" Words failed, and he groped helplessly.

Shawn rose to snatch the precious sword from Briggs' hands, but the universe spun, and he fell back.

"If you really did that," the patrolman gazed wonderingly for the tenth time at a seared and blackened area strewn with twisted metal—of poachers no sign—"I might forget you stole a patrol ship. But how—"

Shawn grinned pridefully. His voice came slowly, but with more firmness than it had had in a long time. "It was in a book. I saw in a book how to make a thing that—well, I don't know exactly what it did, but the book showed how to make it. So I put it in the sword, with a cosmolite crystal to make it work. It would only work once. It was a very special sword."

"It certainly was." Briggs glanced with awe at the sword, and at the place where the forces from it had struck.

"Tell me—" Shawn was eager to know something that had bothered him. "Do you think I could stay here with you and kill dragons? I want to kill dragons."

It was not hard for Briggs to take pity on this big, hulking man whose brains were in his hands.

"Sure," he said. "Rainbow Dragons."

HUNTING BIG GAME

Research is only now getting under way on the most fascinating investigation in astronomy—the super-novas. A single sun gone mad—so wholly, monstrously, uncontrollably mad that it outshines a whole galaxy of suns!

By Harold A. Lower

Illustrated by Orban

Author's Note.

The kindness of Dr. Zwicky in permitting the use of data previously published in the *Astrophysical Journal* and publications of the Astronomical Society of the Pacific is gratefully acknowledged. I am also indebted to him for unpublished information concerning the supernovae.

H. A. L.

SINCE the human mind is quite unable to fully comprehend the meaning of a million, or any ratio of that huge order, we can start with the understanding that it is impossible to form any picture of the supernal violence of the explosion of a star. We can take the Sun as unity, a one-sun-power generator of light and heat. On that basis, this local galaxy generates heat and light—in its myriad stars—at hundreds of millions of sun-power.

A single supernova can, and usually does, give off more light, more heat, *than the combined output of all the stars of an entire galaxy.*

Beside an ordinary nova, a star such as our Sun is cold, dead matter; a supernova is not merely a larger nova—it's a different breed from the start. Many stars are known which radiate normally, millions of years after millions of years, with all the unimaginable intensity of an ordinary nova. One entire class of suns is characterized by a radiation rate higher than the peak explosion rate of an ordinary nova.

Ordinary novae are by no means rare. In a stellar system such as our galaxy, or the spiral nebula M31 in Andromeda, as many as two dozen may appear in a single year. The supernovae, however, are exceedingly rare. Only one has been seen in M31, and so far as is known, only two have occurred in our own galaxy since astronomical records have been kept. Tycho's Star, which appeared in November, 1572, and for a short time was *bright enough to be visible in daylight*, and a star which is mentioned in Chinese and Japanese records of 1054 were probably supernovae.

Several years ago, Dr. Fritz Zwicky, of the California Institute of Technology, and Dr. Baade, of Mount Wilson Observatory, discussed the rare type of temporary stars which have occasionally been known to flare up to a luminosity a thousand times greater than the ordinary nova. As a result of this discussion, they formulated some interesting theories regarding the supernovae, as they decided to call them. One of the theories was that supernovae are an origin of cosmic rays. Another was that the cause of the supernovae process was the transformation of an ordinary star into a *collapsed neutron* star, of

enormous density and exceedingly small stellar radius. In order to test these theories, it was decided that a systematic search for supernovae should be made.

As the evidence indicates that even in a system containing many millions of stars, the particular conditions required to produce a supernova occur, on the average, only at intervals of several centuries, it would be useless to hunt for them in our own galaxy. The extra-galactic nebulae are the only places where stars are sufficiently numerous that there is a chance of one of them becoming a supernova within a reasonable length of time. The problem was more difficult than to just find one particular star in a galaxy. It would be necessary to search *many* galaxies to find a supernova. Finding the proverbial needle in a haystack would be easy, in comparison.

To search the nebulae visually, one at a time, would have been a tremendous task. Quantity-production methods were needed, so plans were made for a systematic search by means of photography. Unfortunately, no suitable instrument was available. After considerable discussion, it was decided that the then-little-known Schmidt camera offered the best solution for the problem, and the California Institute of Technology undertook the construction of an eighteen-inch f/2 Schmidt camera, to be mounted on Mount Palomar, near the site of the 200-inch telescope.

Although the eighteen-inch is small, compared to the great telescope which will soon be its next-door neighbor, it is a powerful instrument. With an exposure of half an hour it can reach stars 25,000 times fainter than the faintest that can be seen with the naked eye. Mounted in a small dome a few hundred yards to the south of the 200-inch dome, the new instrument was put into service on September 5, 1936, the first of the many instruments which will eventually make up the Palomar Observatory.

PATIENTLY, Dr. Zwicky took up the task of photographing the nebulae. Quite a number of constellations contain numerous nebulae which were within the limits that could be reached with the eighteen-inch, so they were photographed as often as possible. In addition, the brighter nearby systems, as well as several dozen faint by resolvable nebulae, were frequently photographed.

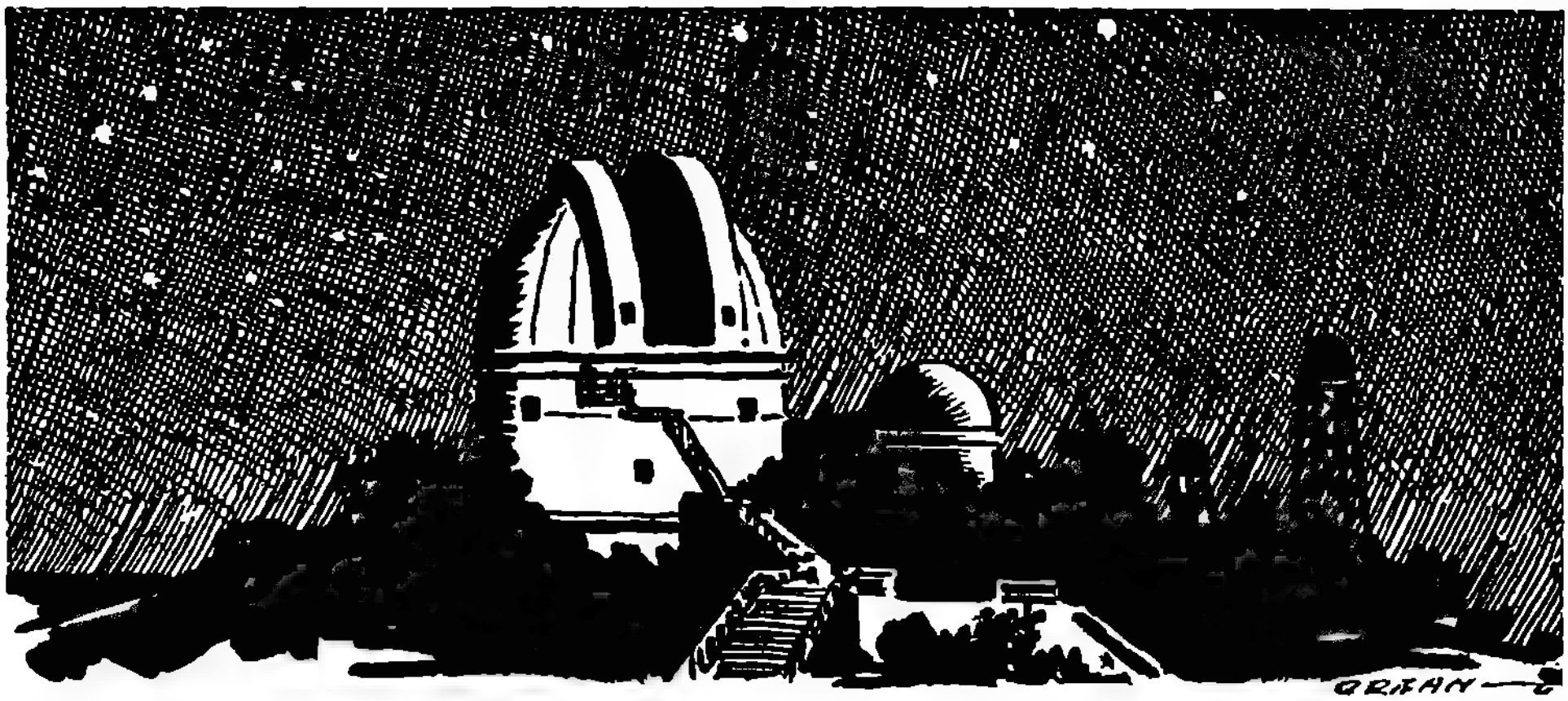
It was in one of these faint nebulae that the brightest of all supernovae was found. This supernova, which appeared in the nebula IC 4182, was by far the brightest celestial object ever observed.

Dr. Baade had for some time been engaged in photographing nebulae of this type with the 100-inch Mount Wilson telescope, in order to determine their distance. Having already found the distance of this particular nebula to be three million light-years, he was able to calculate immediately the absolute magnitude of this supernova.

One of Dr. Zwicky's photographs of this nebula, taken on April 10, 1937, shows the nebula as a faint, misty spot on the negative. No stars can be seen in the nebula. Another photograph of the same region, made on August 26, 1937, shows a star of 8.4 magnitude *in the nebula*. Now the nebula was only of 13.5 magnitude, so this star was actually about 100 times as bright as that entire galaxy, and had the astonishing absolute magnitude of —16.4.

When the absolute magnitude is known, it is a simple matter to calculate brightness of the nova in terms of the Sun. In the case of this particular supernova, it amounts to just about 600 million times the luminosity of the Sun.

ONE MIGHT think that the search for such intensely bright objects would be simple and easy, but that is not the case. In nearly two and a half years



of searching, Dr. Zwicky has found eight supernovae. The number of photographs hàs passed 2,000, and it has been been found that just about 8,000 nebular images must be examined to find one supernova. As eight have been found, that means that more than 60,000 nebulae had to be searched. Lacking a blink comparator suitable for use with the Schmidt negatives, it is necessary to superimpose two identical negatives and examine each nebular image with a glass. It is an eye-straining and nerve-trying job.

Due to the short focal length of the Schmidt, the images of elliptical nebulae and the center parts of some of the spirals are so black that faint novae might easily be missed, unless located in the outer parts of the nebulae. A larger instrument, which would give larger images and also reach fainter stars, is badly needed. The success of the eighteen-inch Schmidt having proven the advantages of this type of instrument, it was decided to construct another Schmidt, this time a really large one. It will have an aperture of forty-eight inches and a focal length of 120 inches, and will be the largest wide-field telescope ever made.

The dome for the new forty-eight-inch instrument is now almost completed, and while actual construction of the instrument had not been started at the time this is written, working drawings have been made, and the six-foot disk of Pyrex glass for the mirror is already in the California Tech optical shop.

The study of the supernovae is costly, both in time and money. Perhaps it is logical to ask just what is being learned that justifies the construction of expensive instruments and the devotion of years of work to this task? From the strictly utilitarian viewpoint, there can be no tangible return from the study of a star which exploded three million years ago. But to a scientist, the acquisition of knowledge is an end in itself. The study of the supernovae affords an opportunity to pry a bit deeper into some of the secrets of nature; to learn a little more about this universe in which we live. What practical use will be made of the knowledge is of little concern to an astronomer, but that it will eventually be of use, he would not doubt.

There is a story about Faraday which illustrates how very short-sighted is the practical person who demands immediate returns from new knowledge. Faraday had demonstrated that when a current of electricity was passed through a coil of wire surrounding a magnet, the magnet moved. A lady in the audience asked, "But, doctor, of what use is it?" Faraday's answer was, "Madam, of what use is a newborn baby?" We all know how *that* baby has grown into

the great electrical industry of today, but who can foresee the developments which will result from our increased knowledge of atomic reactions?

VARIOUS theories have been proposed from time to time, to account for the great outburst of energy that takes place when a star becomes a nova. The normal output of an average star is such a tremendous amount of energy—measured by Earthly standards—that it is no easy task to account for it. When that output is suddenly increased many thousands, or even many millions, of times, the problem becomes even more difficult.

There are two sources of energy which probably combine to supply the normal radiation of a star. One is gravity. If a star is contracting, the work done by gravitation in compressing the gas of which the star is composed will reappear as heat. The amount of heat that can be produced in this manner can be calculated. In the case of our Sun, the energy radiated in one year could be supplied by a reduction in diameter of 280 feet. The other source of energy, and the one which probably supplies by far the greater amount, is within the atoms of which the star is composed. It is more difficult to calculate the amount of energy produced by changes within the atom, because we do not, as yet, know all the changes that can take place.

It has sometimes been suggested that the additional energy which appears when a star becomes a nova might be supplied by an external source, such as the kinetic energy of some body that collides with the star. If the body was even of planetary dimensions, and traveling at high speed, this could produce a very large amount of energy.

If two stars passed fairly close to one another, the tidal effects produced by the mutual gravitational pulls of the two stars might disrupt them sufficiently to expose some of the intensely hot matter in the interior of the stars. As the in-

terior temperatures are computed at many millions of degrees, it is evident that a tremendous amount of energy would be radiated until the exposed matter had cooled.

At first thought, this seems a likely solution, as the theory which is most in favor at present, regarding the formation of the planets from matter which was torn from the Sun, assumes that it occurred because of the gravitational pull of another star which passed close to the Sun. If seen from a distance, the effect would probably have been very similar to a nova. One is tempted to assume that the outburst of a nova represents the birth of a planetary system.

However, stellar collisions, or even the close approach of two stars, are probably very rare events. The great distances between the stars make the chance that two stars would approach each other closely enough to cause such an outburst an extremely remote possibility.

THE NEXT contingency that might be considered is that some stars may be unstable, and for some reason the normal process of energy release gets out of control and temporarily increases enormously. Perhaps this is what happens in the ordinary nova. The outer layers of gas are blown off, the radiation from the intensely hot inner layers causes a great increase in the brightness of the star. Radiation and expansion would soon cool the exposed layers, and in a short time the star would return to approximately its former condition. Only a small amount of matter has been blown off the surface of the star. It has radiated but a fraction of its total energy. However, any theory, to be acceptable, must logically account for the amount of energy which the observations show is liberated.

A supernova represents a tremendously larger output of energy than an ordinary nova. More than can be accounted for merely by assuming that it is the radiation of stored heat. On the other hand, it is not *enough* energy for us to assume that the matter composing the star has been completely destroyed by conversion into energy. Theoretically, a pound of matter, if it could be completely converted into energy, would produce enough heat to change twenty million tons of rock into incandescent lava. If this change of matter into energy occurred in the supernovae, the output of energy would be even greater than the amount that the observations show.

If a star should suddenly contract to the size of a White Dwarf, gravitational forces would provide an enormous amount of energy. In the case of a star like our Sun, the quantity would be approximately as much as would normally be radiated in fifteen million years. But one of the supernovae which Dr. Zwicky discovered radiated as much energy in the first 200 days as our Sun does in forty million years.

IT has been suggested that if the star that became this extremely bright supernova had originally been as bright as the star S Doradus, which has a normal output about equal to an ordinary nova, it would have only needed to increase its radiation about as much, to become a supernova, as a solar-type star would have to increase to become an ordinary nova. Now that seems logical. Was the star that appeared in IC 4182, and at maximum was 600 million times as bright as the Sun, a supergiant before the outburst? The question is easily answered by examination of photographs made before the outburst.

A negative made on April 10, 1937, shows no trace of the nova. The distance of the nebula is three million light-years, and it is easily calculated that at that distance a star as bright as S Doradus would appear of the seventeenth

magnitude. The Schmidt negatives show stars half a magnitude fainter than that. Photographs that had been made with the 100-inch telescope did not show a star in that location, so the star which became the very bright supernova must have originally been at least five magnitudes fainter than S Doradus.

Another indication that stars which become supernovae are not necessarily excessively bright stars before the outburst is the fact that the most recently discovered supernova occurred in an elliptical nebula. Nebulae of this type are not resolvable.

The outer parts of the spiral M31 in Andromeda, can be resolved with the 100-inch telescope, but the elliptical nebula which is located near one edge of the spiral, and at approximately the same distance, cannot be resolved. The inference is that elliptical nebulae do not contain any extremely bright stars. In fact, the discovery of a supernova in a nebula of this type is about the only direct evidence that this kind of nebulae contain stars.

But to get back to the question of the source of energy necessary to produce a supernova. In some recent reports, Dr. Zwicky suggested that the occurrence of a supernova might be due to the transformation of an ordinary star, composed mainly of electrically charged particles, into a *collapsed neutron* star of enormous density and exceedingly small stellar radius. This is rather a startling theory, but it is based on scientific reasoning, and there is observational evidence to support it.

PHYSICISTS have been doing such surprising things to atoms lately that one has great difficulty in trying to keep up with developments. But it seems probable that things can happen in the interior of stars that as yet cannot be duplicated in the laboratory. The spectrum of the supernova indicates that things are happening in the supernova that are quite different from anything that occurs in the laboratory, or even in ordinary stars.

Normal atoms, or partially ionized atoms, emit light which when analyzed with the spectroscope, produces a line spectrum. If additional force is applied to the atoms of a gas, more electrons are stripped off, and the more highly ionized gas emits more spectral lines. In some cases the already existing lines are widened. Now, the spectrum of a supernova is different from that of any other object. No force which can be applied in the laboratory has yet been able to produce a spectrum to match it.

The line spectrum of an ordinary star usually contains lines which can easily be matched by laboratory light sources. But the spectrum of a supernova consists mainly of very wide *bands*. These wide bands are partly due to a Doppler effect, but they may also indicate that the gases of the supernova are ionized far beyond anything with which we are familiar.

The hot gases a short distance below the surface of an ordinary star are believed to be composed largely of ionized atoms and free electrons. The atoms in most cases would retain part of their electrons. At only a moderate depth such a gas would be quite opaque. Radiation from the interior of the star could not escape freely, but would have to be passed on from atom to atom until it reached a point near enough to the surface for the lesser density of the gas to permit it to escape. Only a thin surface layer would be transparent enough to permit energy to escape as light.

Light pressure seems like a very feeble force, but it can reach very respectable proportions in the interior of a star, where the gases are sufficiently dense to be opaque. An atom is quite a bulky affair, in comparison to its mass, and the atoms of a dense, opaque gas would trap radiation which was trying to get

out of the star. The resulting light pressure might, to a very considerable extent, balance the opposite pull of gravitation.

Suppose now that some force, instead of just stripping off a few electrons from the gases composing the outer layers of a star, should strip off all or nearly all of the electrons? Suppose the atoms were converted into neutrons, ions, and free electrons? Neutrons, while infinitely smaller than the original atoms, still retain nearly all of their original mass.

Ions and electrons would be pushed toward the surface of the star by light pressure. Neutrons have no electrical charge and, therefore, are not subject to light pressure, but gravity would be pulling on them nearly as hard as before. They would at once begin to sink toward the center of the star. As a result, the gases composing the star would become more and more transparent. Radiation could escape more freely.

Perhaps something of this sort may occur in all stars. There may be a small core of neutrons at the center of every normal star, but in the majority of cases the change takes place very slowly and most of the atoms are normal ones. The gases are so opaque that radiation is kept under strict control, and leaks out into space so slowly that a normal star can continue to radiate for billions of years. In the ordinary nova, the process may get partly out of control and the sudden release of energy blows off the surface layers. But the deeper layers expand, and the opaque layer is restored as the normal atoms expand and cool. The outburst subsides, and in a comparatively short time the star returns to approximately its former condition.

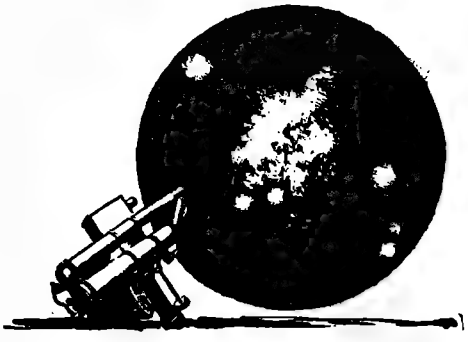
In the supernovae, the change takes place suddenly, and seems to be progressive. The outer layers of the star become more and more transparent. Radiation escapes more and more freely. Not only light escapes. Much of the energy is probably in the form of free

electrons, ultraviolet radiation and cosmic rays. The radiation between 6,500 A and 3,800 A, which registers on the photographic place, is only a small percentage of the total amount.

A tremendous amount of gas composed of ordinary atoms will be blown off of the surface of the star as soon as the interior gases have become transparent enough to permit energy to escape from the interior in the form of radiation. This gas, normally opaque, is driven off so violently by the unleashed energy, that it expands until—as the spaces between the atoms increase—it, too, becomes transparent, and we see the central core of the collapsing star.

Theoretically, it is possible to calculate the amount of energy that would be liberated by the conversion of a normal solar-type star into a collapsed neutron star. It is a very large amount, but not nearly so much as would be produced by the total annihilation of matter. If the collapsed-neutron-star theory is correct, matter is not annihilated; it is merely changed. Most of the original mass of the star still remains in the enormously shrunken, tremendously dense neutron core. The observations indicate that the energy released is just about the amount required by the theory.

THERE is yet another way in which the neutron-star theory may be checked.



You, no doubt, remember that Einstein predicted that gravitation could act on light. Tests were made by photographing stars near the Sun during total eclipses. When the plates were measured, the predicted shift was verified. The same theory also indicated that light leaving a very massive body, where the gravitational field was extremely powerful, would have the lines of the spectrum shifted toward the red. This shift was so small for our Sun that it was very difficult to detect, but in the case of very dense stars, such as the White Dwarf companion of Sirius, the gravitational field is very strong, and the predicted shift was found.

Neutrons, having no electrical charge, would not repel each other and could pack together very closely, forming a body of very small diameter, but having an enormous gravitational field. Light leaving such a body should show a large gravitational shift toward the red.

It is an interesting fact that spectrograms taken by Dr. Minkowski at Mount Wilson have shown that as a supernova fades, all the characteristic features of its spectrum gradually shift toward the red. In the case of the supernova in IC 4182, by the time the brightness had fallen to about one million times that of the Sun, the red shift amounted to about 100 A. Assuming that this is a gravitational shift, it is possible to calculate some of the physical characteristics of the central star at this stage.

For a central star having the mass of the Sun, Dr. Zwicky has calculated that at this time the core of the supernova had a radius of seventy-four kilometers, a density in excess of twenty million tons per cubic inch, and a surface temperature of eighteen million degrees.

That a star as massive as the Sun could, in less than a year, contract to the size of an asteroid, seems almost incredible. Yet the formulas employed

in the calculation have proven quite reliable when applied to stars in our own galaxy, where the solution could be verified by other methods.

Imagine, if you can, the intolerable brilliancy of that tiny ball, still one million times brighter than our Sun, with nearly all of the enormous mass of a full-size star. The surface gravity would be beyond comprehension. One feels surprise that light could escape at all from such a surface. And remember, this was not the end. The star was still contracting at this time. A density of twenty million tons per cubic inch is far beyond that of the most massive White Dwarf previously known, but by the time the star finally cooled, it would have shrunk still farther. Evidently matter can exist in forms which we had not even imagined. Such dense matter, if we had a sample here on Earth, could not even be examined. It would sink through the hardest steel armor plate quite as readily as a bullet would sink in water, and would come to rest only when it had reached the center of the Earth.

If the neutron-star hypothesis is correct, and the spectrographic evidence so far obtained supports it, then it is no longer surprising that the remains of supernovae in our own galaxy are so difficult to find. The star has been converted by contraction from a body of very high luminosity to one of very low luminosity. Once cooled, the tiny, massive core would be almost impossible to detect. Perhaps the expanding shell of gas which was blown off might be detected, if it could be recognized among all the other gaseous nebulae.

In a galaxy the size of ours, which has been in existence for at least two billion years, it is probable that the dead cores of supernovae may number several million, yet in only a single case, that of the Crab nebula in Taurus, it is possible that the remains of a supernova that occurred in our own galaxy has been found. Careful measurements, and the Doppler shift in spectrograms of this nebula, show that it is expanding. The distance of this nebula is 5,000 light-years, so its actual diameter is readily determined. As the spectrograms show the rate of expansion, it is possible, by reckoning backward, to find the date when the nebula started to expand. Apparently it was about 900 years ago.

Only recently, study of old Chinese and Japanese astronomical records revealed that in the year 1054 a temporary star blazed out in the constellation of Taurus, in just the position where we now find the Crab nebula. This star is mentioned in the old records as having been as bright as Jupiter. For a star at a distance of 5,000 light-years to appear so brilliant, its actual luminosity must have been great enough to place it in the class of the supernovae.

The expanding shell of gas blown off by an ordinary nova has been seen in several cases. Six months after the outburst of Nova Aquilae, in 1918, the shell of gas became visible in large telescopes as a faint, greenish, nebulous envelope surrounding the star. This envelope increased in diameter at the rate of two seconds of arc per year. There is, of course, no hope of seeing this expanding shell of gas in the case of supernovae which occur in extra-galactic nebulae, but the spectrograms indicate that it exists.

As previously mentioned, the spectrum of a supernova consists mainly of very wide bands. At least part of the width of these bands is presumably due to the Doppler shift produced by the expanding shell. Light coming from the near side of the shell would be shifted toward the violet by an amount corresponding to the velocity of approach. Light from the far side of the shell would be shifted toward the red, as gases in that part of the shell would be re-

ceding. The gas in other parts of the shell would have different velocities, relative to the line of sight, and the result of the combined shifts would be to convert even a sharp spectral line into a broad band. A number of other problems of the spectrum of supernovae remain to be solved, and the solutions, when obtained, should afford further checks of important theories.

IF A SUPERNOVA should occur in our galaxy, it could be studied much more readily than an object distant millions of light-years, which can only be reached by the most powerful instruments. Such a supernova would be greatly appreciated by astronomers, provided it was not *too* close.

So far as is known at present, any star might become a nova or supernova, so it is interesting to calculate what would happen if one of the nearer stars should become a supernova. If it should be our Sun—well, we would lose all interest in astronomy about eight minutes after it happened! In a few hours, even the distant planets would be converted into masses of flaming gas. Perhaps it would be just as well if the supernova occurred just a little farther away?

The nearest star is at a distance of about four light-years. Would that be far enough for the Earth to escape unharmed? It is possible, but by no means certain. At a distance of four light-years, a supernova would be only about one-percent as bright as the Sun. To equal the Sun, it would have to be a little nearer than half a light-year, and there are no stars that close.

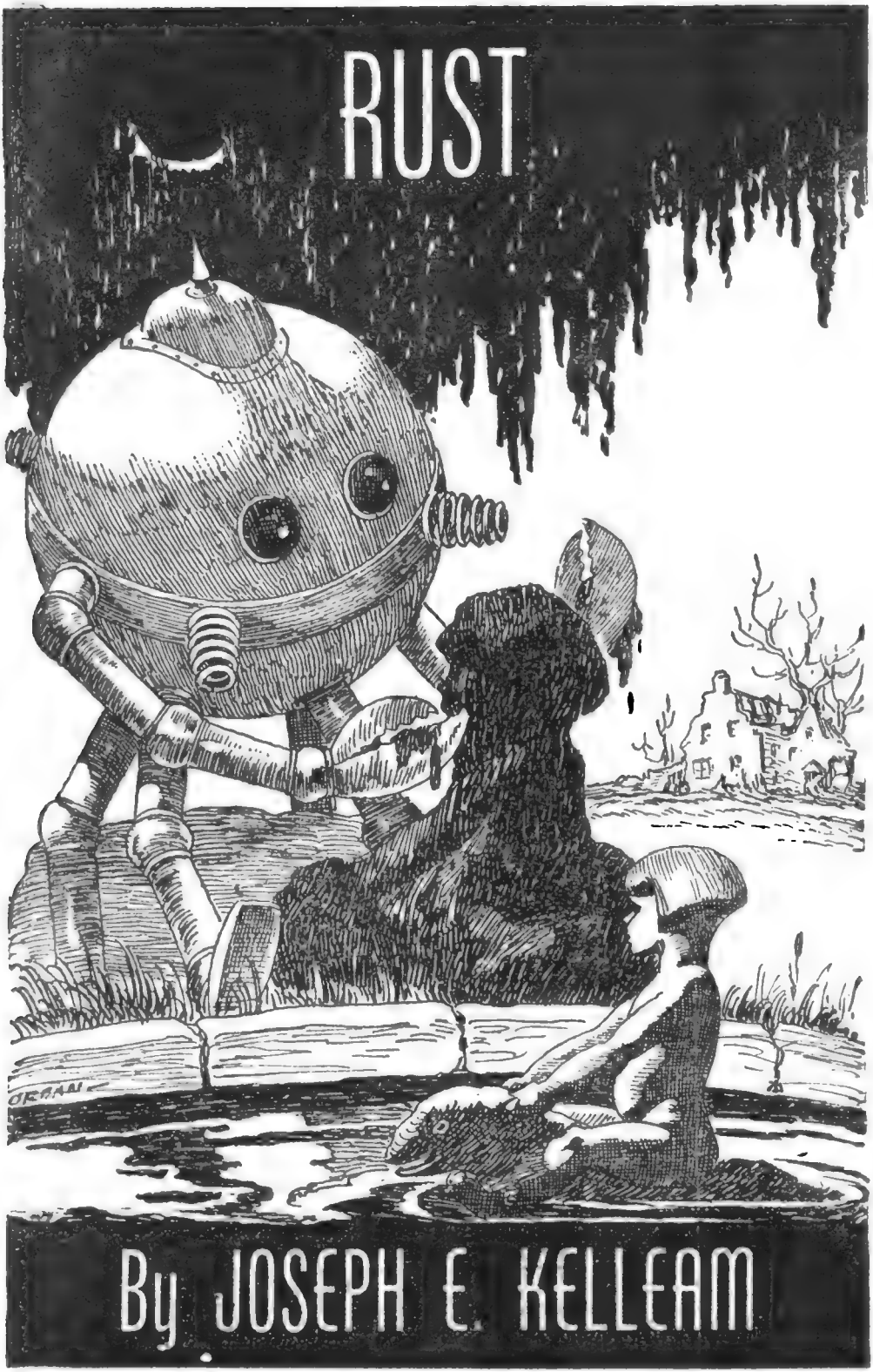
Even at a distance of four light-years, a supernova might cause us considerable discomfort. Our Sun emits ultraviolet radiation that would be decidedly dangerous if it were not screened out by the ozone in the upper atmosphere. The quantity of ozone in the atmosphere is not great; only about enough to make a layer three eighths of an inch thick, at sea-level pressure.

At the extremely high temperatures that exist in supernovae, a very large percentage of the radiation must be of very short wave length, and highly dangerous to all living things. Would that three eighths of an inch of ozone be enough of a shield, or would humanity have to burrow deep in the earth to escape the deadly radiation?

The study of the supernovae will be continued, and as more powerful instruments become available, more will be learned about them. In the present stage of the investigation, it becomes apparent that matter can exist in forms which had not previously been known.

The probability that gravitational fields exist which are tremendously more intense than had previously been suspected opens up a fascinating field for further study. What happens to light in such a field? How will nuclear reactions be modified when they take place inside a collapsed neutron star, where even the properties of *time* and *space* may be radically changed?

Such questions may be answered in the future, but it seems probable that many years will be required before all the problems are solved. But of this we may be sure: the study of the supernovae has opened up another treasure house of nature's secrets, and as yet we have had but a glimpse of what it may contain.


RUST
By JOSEPH E. KELLEAM

RUST

Delicate distinctions are very hard for ruggedly built war machinery— And they weren't designed for constructive work—

By Joseph E. Kelleam

Illustrated by Orban

THE sun, rising over the hills, cast long shadows across the patches of snow and bathed the crumbling ruins in pale light. Had men been there they could have reckoned the month to be August. But men had gone, long since, and the sun had waned; and now, in this late period of the earth's age, the short spring was awakening.

Within the broken city, in a mighty-columned hall that still supported a part of a roof, life of a sort was stirring. Three grotesque creatures were moving, their limbs creaking dolefully.

X-120 faced the new day and the new spring with a feeling of exhilaration that nearly drove the age-old loneliness and emptiness from the corroded metal of what might be called his brain. The sun was the source of his energy, even as it had been the source of the fleshy life before him; and with the sun's reappearance he felt new strength coursing through the wires and coils and gears of his complex body.

He and his companions were highly developed robots, the last ever to be made by the Earthmen. X-120 consisted of a globe of metal, eight feet in diameter, mounted upon four many-jointed legs. At the top of this globe was a protuberance like a kaiser's helmet which caught and stored his power from the rays of the sun.

From the "face" of the globe two ghostly quartz eyes bulged. The globe was divided by a heavy band of metal at its middle, and from this band, at each side, extended a long arm ending in a powerful claw. This claw was like the pincers of a lobster and had been built to shear through metal. Four long cables, which served as auxiliary arms, were drawn up like springs against the body.

X-120 stepped from the shadows of the broken hall into the ruined street. The sun's rays striking against his tarnished sides sent new strength coursing through his body. He had forgotten how many springs he had seen. Many generations of twisted oaks that grew among the ruins had sprung up and fallen since X-120 and his companions had been made. Countless hundreds of springs had flitted across the dying earth since the laughter and dreams and follies of men had ceased to disturb those crumbling walls.

"The sunlight is warm," called X-120. "Come out, G-3a and L-1716. I feel young again."

His companions lumbered into the sunlight. G-3a had lost one leg, and moved slowly and with difficulty. The steel of his body was nearly covered with red rust, and the copper and aluminum alloys that completed his make-up were pitted with deep stains of greenish black. L-1716 was not so badly tarnished, but he had lost one arm; and

the four auxiliary cables were broken and dangled from his sides like trailing wires. Of the three X-120 was the best preserved. He still had the use of all his limbs, and here and there on his body shone the gleam of untarnished metal. His masters had made him well.

The crippled G-3a looked about him and whined like an old, old man. "It will surely rain," he shivered. "I cannot stand another rain."

"Nonsense," said L-1716, his broken arms, scraping along the ground as he moved, "there is not a cloud in the sky. Already I feel better."

G-3a looked about him in fear. "And are we all?" he questioned. "Last winter there were twelve."

X-120 had been thinking of the other nine, all that had been left of the countless horde that men had once fashioned. "The nine were to winter in the jade tower," he explained. "We will go there. Perhaps they do not think it is time to venture out."

"I cannot leave my work," grated G-3a. "There is so little time left. I have almost reached the goal." His whirring voice was raised to a pitch of triumph. "Soon I shall make living robots, even as men made us."

"The old story," sighed L-1716. "How long have we been working to make robots who will take our places? And what have we made? Usually **nothing** but lifeless blobs of steel. Sometimes we have fashioned mad things that had to be destroyed. But never in all the years have we made a single robot that resembled ourselves."

X-120 stood in the broken street, and the sunlight made a shimmering over his rust-dappled sides.

"That is where we have failed," he mused as he looked at his clawlike arms. "We have tried to make robots like ourselves. Men did not make us for life; they fashioned us for death." He waved his huge lobster claw in the air. "What was this made for? Was it made for the shaping of other robots? Was it made to fashion anything? Blades like that were made for slaughter —nothing else."

"Even so," whined the crippled robot, "I have nearly succeeded. With help I can win."

"And have we ever refused to help?" snapped L-1716. "You are getting old, G-3a. All winter you have worked in that little dark room, never allowing us to enter."

There was a metallic cackle in G-3a's voice. "But I have nearly won. They said I wouldn't, but I have nearly won. I need help. One more operation. If it succeeds, the robots may yet rebuild the world."

Reluctantly X-120 followed the two back into the shadowy ruins. It was dark in there; but their round, glassy eyes had been made for both day and night.

"See," squeaked old G-3a, as he pointed to a metal skeleton upon the floor. "I have remade a robot from parts that I took from the scrap heap. It is perfect, all but the brain. Still, I believe this will work." He motioned to a gleaming object upon a littered table. It was a huge copper sphere with two black squares of a tarlike substance set into it. At the pole opposite from these squares was a protuberance no larger than a man's fist.

"This," said G-3a thoughtfully, "is the only perfect brain that I could find. You see, I am not trying to create something; I am merely rebuilding. Those" —he nodded to the black squares—"are the sensory organs. The visions from the eyes are flashed upon these as though they were screens. Beyond those eyes is the response mechanism, thousands and thousands of photo-electric cells. Men made it so that it would react mechanically to certain images. Movement, the simple avoidance of ob-

jects, the urge to kill, these are directed by the copper sphere.

"Beyond this"—he gestured to the bulge at the back of the brain—"is the thought mechanism. It is what made us different from other machines."

"It is very small," mocked X-120.

"So it is," replied G-3a. "I have heard that it was the reverse with the brains of men. But enough! See, this must fit into the body—so. The black squares rest behind the eyes. That wire brings energy to the brain, and those coils are connected to the power unit which operates the arms and legs. That wire goes to the balancing mechanism—" He droned on and on, explaining each part carefully. "And now," he finished, "someone must connect it. I cannot."

L-1716 stared at his one rusty claw with confusion. Then both he and G-3a were looking at X-120.

"I can only try," offered the robot. "But remember what I said. We were not fashioned to make anything; only to kill."

CLUMSILY he lifted the copper sphere and its cluster of wires from the table. He worked slowly and carefully. One by one the huge claws crimped the tiny wires together. The job was nearly finished. Then the great pincers, hovering so carefully above the last wire, came into contact with another. There was a flash as the power short-circuited. X-120 reeled back. The copper sphere melted and ran before their eyes.

X-120 huddled against the far wall. "It is as I said," he moaned; "we can build nothing. We were not made to work at anything. We were only made for one purpose, to kill." He looked at his bulky claws, and shook them as though he might cast them away.

"Do not take on so," pacified old G-3a. "Perhaps it is just as well. We are things of steel, and the world seems to be made for creatures of flesh and blood—little, puny things that even I can crush. Still, that thing there"—he pointed to the metal skeleton which now held the molten copper like a crucible—"was my last hope. I have nothing else to offer."

"Both of you have tried," agreed L-1716. "No one could blame either of you. Sometimes of nights when I look into the stars, it seems that I see our doom written there; and I can hear the worlds laughing at us. We have conquered the earth, but what of it? We are going now, following the men who fashioned us.

"Perhaps it is better," nodded X-120. "I think it is the fault of our brains. You said that men made us to react mechanically to certain stimuli. And though they gave us a thought mechanism, it has no control over our reactions. I never wanted to kill. Yet, I have killed many men-things. And sometimes, even as I killed, I would be thinking of other things. I would not even know what had happened until after the deed was done."

G-3a had not been listening. Instead, he had been looking dolefully at the metal ruin upon the floor. "There was one in the jade tower," he said abruptly, "who thought he had nearly learned how to make a brain. He was to work all winter on it. Perhaps he has succeeded."

"We will go there," shrilled L-1716 laconically.

But even as they left the time-worn hall G-3a looked back ruefully at the smoking wreckage upon the floor.

X-120 slowed his steps to match the feeble gait of G-3a. Within sight of the tower he saw that they need go no farther. At some time during the winter the old walls had buckled. The nine were buried beneath tons and tons of masonry.

Slowly the three came back to their broken hall. "I will not stay out any longer," grumbled G-3a. "I am very

old. I am very tired." He crept back into the shadows.

L-1716 stood looking after him. "I am afraid that he is nearly done," he spoke sorrowfully. "The rust must be within him now. He saved me once, long ago, when we destroyed this city."

"Do you still think of that?" asked X-120. "Sometimes it troubles me. Men were our masters."

"And they made us as we are," growled L-1716. "It was not our doing. We have talked of it before, you know. We were machines, made to kill—"

"But we were made to kill the little men in the yellow uniforms."

"Yes, I know. They made us on a psychological principle: stimulus, response. We had only to see a man in a yellow uniform and our next act was to kill. Then, after the Great War was over, or even before it was over, the stimulus and response had overpowered us all. It was only a short step from killing men in yellow uniforms to killing all men."

"I know," said X-120 wearily. "When there were more of us I heard it explained often. But sometimes it troubles me."

"It is all done now. Ages ago it was done. You are different, X-120. I have felt for long that there is something different about you. You were one of the last that they made. Still, you were here when we took this city. You fought well, killing many."

X-120 sighed. "There were small men-things then. They seemed so soft and harmless. Did we do right?"

"Nonsense. We could not help it. We were made so. Men learned to make more than they could control. Why, if I saw a man today, crippled as I am, I would kill him without thinking."

"L-1716," whispered X-120, "do you think there are any men left in the world?"

"I don't think so. Remember, the Great War was general, not local. We were carried to all parts of the earth, even to the smallest islands. The robots' rebellion came everywhere at almost the same time. There were some of us who were equipped with radios. Those died first, long ago, but they talked with nearly every part of the world." Suddenly he wearied of speech. "But why worry now. It is spring. Men made us for killing men. That was their crime. Can we help it if they made us too well?"

"Yes," agreed X-120, "it is spring. We will forget. Let us go toward the river. It was always peaceful and beautiful there."

L-1716 was puzzled. "What are peace and beauty?" he asked. "They are but words that men taught us. I have never known them. But perhaps you have. You were always different."

"I do not know what peace and beauty are, but when I think of them I am reminded of the river and of—" X-120 stopped suddenly, careful that he might not give away a secret he had kept so long.

"Very well," agreed L-1716, "we will go to the river. I know a meadow there where the sun always seemed warmer."

THE TWO machines, each over twelve feet high, lumbered down the almost obliterated street. As they pushed their way over the débris and undergrowth that had settled about the ruins, they came upon many rusted skeletons of things that had once been like themselves. And toward the outskirts of the city they crossed over an immense scrap heap where thousands of the shattered and rusted bodies lay.

"We used to bring them here after—" said L-1716. "But the last centuries we have left them where they have fallen. I have been envying those who wintered in the jade tower." His metallic voice hinted of sadness.

They came at last to an open space

in the trees. Farther they went and stood at the edge of a bluff overlooking a gorge and a swirling river below. Several bridges had once been there but only traces remained.

"I think I will go down to the river's edge," offered X-120.

"Go ahead. I will stay here. The way is too steep for me."

So X-120 clambered down a half-obliterated roadway alone. He stood at last by the rushing waters. Here, he thought, was something that changed the least. Here was the only hint of permanence in all the world. But even it changed. Soon the melting snow would be gone and the waters would dwindle to a mere trickle. He turned about and looked at the steep side of the gorge. Except for the single place where the old roadbed crept down, the sides rose sheer, their crests framed against the blue sky. These cliffs, too, were lasting.

Even in spring the cliffs and river seemed lonely and desolate. Men had not bothered to teach X-120 much of religion or philosophy. Yet somewhere in the combination of cells in his brain was a thought which kept telling him that he and his kind were suffering for their sins and for the sins of men before them.

And perhaps the thought was true. Certainly, men had never conquered their age-old stupidity, though science had bowed before them. Countless wars had taken more from men than science had given them. X-120 and his kind were the culmination of this primal killer instinct.

In the haste of a war-pressed emergency man had not taken the time to refine his last creation, or to calculate its result. And with that misstep man had played his last card on the worn gaming table of earth. That built-in urge to kill men in yellow uniforms had changed, ever so slightly, to an urge to kill—men.

Now there were only X-120, his two crippled comrades, the heaps of rusted steel, and the leaning, crumbling towers.

He followed the river for several miles until the steep sides lessened. Then he clambered out, and wandered through groves of gnarled trees. He did not wish to go back to L-1716, not just yet. The maimed robot was always sad. The rust was eating into him, too. Soon he would be like G-3a. Soon the two of them would be gone. Then he would be the last. An icy surge of fear stole over him. He did not want to be left alone.

HE LUMBERED onward. A few birds were stirring. Suddenly, almost at his feet, a rabbit darted from the bushes. X-120's long jointed arms swung swiftly. The tiny animal lay crushed upon the ground. Instinctively he stamped upon it, leaving only a bloody trace upon the new grass.

Then remorse and shame stole over him. He went on silently. Somehow the luster of the day had faded for him. He did not want to kill. Always he was ashamed, after the deed was done. And the age-old question went once more through the steel meshes of his mind: Why had he been made to kill?

He went on and on, and out of long habit he went furtively. Soon he came to an ivy-covered wall. Beyond this were the ruins of a great stone house. He stopped at what had once been a garden. Near a broken fountain he found what he had been seeking, a little marble statue of a child, weathered and discolored. Here, unknown to his companions, he had been coming for years upon countless years. There was something about this little sculpturing that had fascinated him. And he had been half ashamed of his fascination.

He could not have explained his feelings, but there was something about the statue that made him think of all the things that men had possessed. It reminded him of all the qualities that

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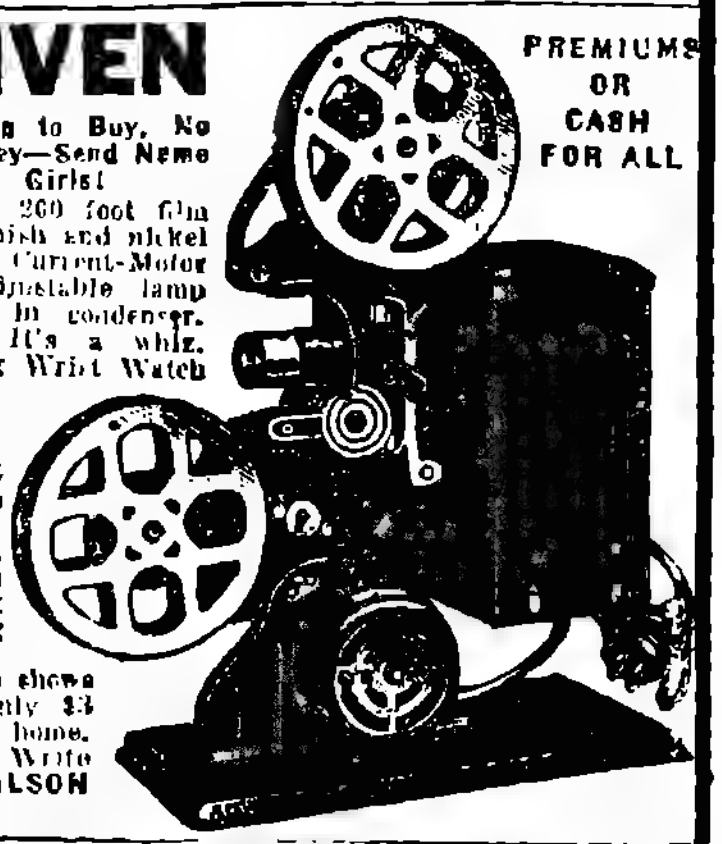

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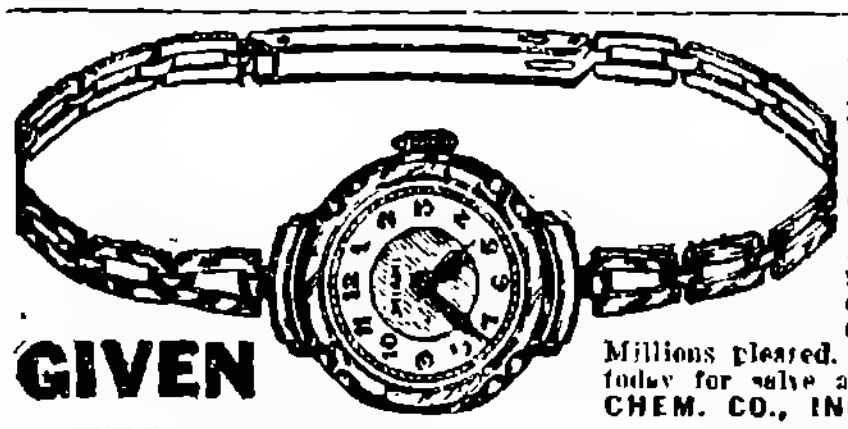

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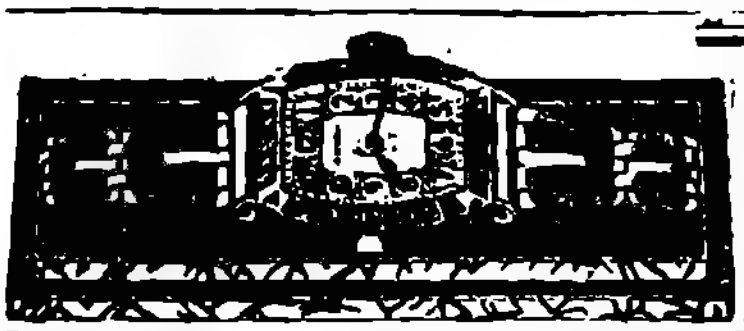

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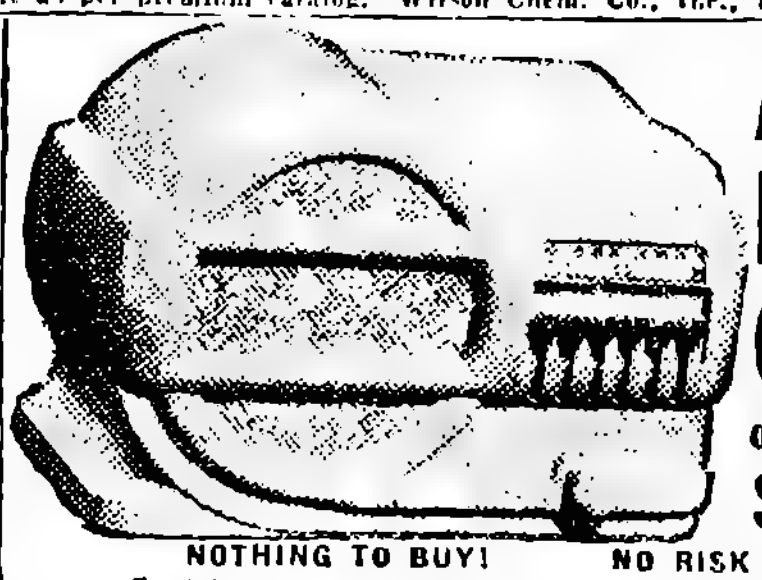

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were so far beyond his kind. He stood looking at the statue for long. It possessed an ethereal quality that still defied time. It made him think of the river and of the overhanging cliffs. Some long-dead artist almost came to life before his quartz eyes.

He retreated to a nearby brook and came back with a huge ball of clay. This in spite of the century-old admonitions that all robots should avoid the damp. For many years he had been trying to duplicate the little statue. Now, once more, he set about his appointed task. But his shearlike claws had been made for only one thing, death. He worked clumsily. Toward sundown he abandoned the shapeless mass that he had fashioned and returned to the ruins.

Near the shattered hall he met L-1716. At the entrance they called to G-3a, telling him of the day's adventures. But no answer came. Together they went in. G-3a was sprawled upon the floor. The rust had conquered.

THE ELUSIVE spring had changed into even a more furtive summer. The two robots were coming back to their hall on an afternoon which had been beautiful and quiet. L-1716 moved more slowly now. His broken cables trailed behind him, making a rustling sound in the dried leaves that had fallen.

Two of the cables had become entangled. Unnoticed, they caught in the branches of a fallen tree. Suddenly L-1716 was whirled about. He sagged to his knees. X-120 removed the cables from the tree. But L-1716 did not get up. "A wrench," he said brokenly; "something is wrong.

A thin tendril of smoke curled up from his side. Slowly he crumpled. From within him came a whirring sound that ended in a sharp snap. Tiny flames burst through his metal sides. L-1716 fell forward.

And X-120 stood over him and begged, "Please, old friend, don't leave me now." It was the first time that the onlooking hills had seen any emotion in centuries.

A FEW flakes of snow were falling through the air. The sky looked gray and low. A pair of crows were going home, their raucous cries troubling an otherwise dead world.

X-120 moved slowly. All that day he had felt strange. He found himself straying from the trail. He could only move now by going in a series of arcs. Something was wrong within him. He should be back in the hall, he knew, and not out in this dangerous moisture. But he was troubled, and all day he had wandered, while the snowflakes had fallen intermittently about him.

On he went through the gray, chill day. On and on until he came to crumbling wall, covered with withered ivy. Over this he went into a ruined garden, and paused at a broken fountain, before an old and blackened statue.

Long he stood, looking down at the carving of a little child, a statue that men had made so long before. Then his metal arm swung through the air. The marble shivered into a hundred fragments.

Slowly he turned about and retraced his steps. The cold sun was sinking, leaving a faint amethyst stain in the west. He must get back to the hall. Mustn't stay out in the wet, he thought.

But something was wrong. He caught himself straying from the path, floundering in circles. The light was paling, although his eyes had been fashioned for both day and night.

Where was he? He realized with a start that he was lying on the ground. He must get back to the hall. He struggled, but no movement came. Then, slowly, the light faded and flickered out.

And the snow fell, slowly and silently, until only a white mound showed where X-120 had been.

EARTH'S SECOND MOON

Does Earth have a second, unseen moon? Or could it capture one from the near-passing asteroids? Ley shows the answer astronomers have found.

By Willy Ley

Illustrated by Willy Ley

AMONG the many astronomical problems that, in the course of research, have presented themselves to test the skill of the experts and to excite the imagination of the public, there is hardly another one that is as interesting, as intriguing and, in a sense, of such immediate concern as that of Earth's Second Moon.

The problem made its first appearance about eighty years ago when the French astronomer Frédéric Petit of Toulouse published the results of some calculations he had made. These calculations seemed to indicate that a second moon of Earth was, at least, possible. But although a similar, only greater, piece of mathematical work—Leverrier's and Adams' calculation of Neptune's existence and orbit from the disturbances in the orbit of Uranus—had just found glorious verification through actual discovery of the planet by Galle in Berlin, nobody paid much attention to Petit's work. Possibly because some felt that he had tried to emulate Leverrier, and, too, Petit had strongly emphasized that it would be almost impossible to ever see the tiny satellite he had predicted.

Petit's calculations would probably have been forgotten very quickly and completely if there had not been a series of rather curious coincidences that perpetuated the question whether there is such a thing as a second moon of Earth. One important factor was that Jules Verne had somehow learned of Petit's hypothetical second moon and used it in one of the early chapters of his famous novel "Round the Moon," the sequel to his "From the Earth to the Moon."

The episode deserves to be quoted in part—translated from the Paris edition of 1866:

> When Barbicane was about to leave the window his attention was attracted by the approach of a brilliant object. It was an enormous disk, the colossal dimensions of which could not be estimated. Its face, which was turned in the direction of the Earth, was very bright. One might have thought it a small moon reflecting the light of the large one. It approached with a high velocity and seemed to travel on an orbit around the Earth which would intersect that of the projectile. . Instinctively the travelers drew back, but their great fear lasted only for seconds. The object passed several hundred yards from the projectile and disappeared, not so much because it traveled so rapidly, but mainly because its dark side merged into the blackness of space.
>
> "Bon voyage," said Michel Ardan with a sigh of relief, "certainly there is enough room in infinite space for a miserable little projectile to walk along its path. Now what was this globe that almost struck us?"
>
> "I know!" replied Barbicane.
>
> "Oh, of course! You know everything."

"It is," said Barbicane, "a simple meteorite, but an enormous one, retained as a satellite by the attraction of the Earth."

"Is that possible?" exclaimed Michel Ardan, "the Earth has two moons like Neptune?" *

"Yes, my friend, it has two moons although it is usually believed to have only one. But this second moon is so small and its velocity so great that the inhabitants of Earth cannot see it. It was by noticing disturbances that a French astronomer, Monsieur Petit, could determine the existence of this second moon and calculate its orbit. According to him a complete revolution around Earth takes three hours and twenty minutes. ."

"Do all astronomers admit the existence of this satellite?" asked Nicholl.

"No," replied Barbicane, "but if, like us, they had met it they could no longer doubt it. . . But this gives us a means to determine our position in space . its distance is known and we were, therefore, 4,700 miles above the surface of our globe when we met it."

The enormous popularity of Jules Verne's novels proved to be an important factor in the history of the Second Moon. When the novels were being written Petit's hypothesis was all but forgotten. After the novels were printed the idea assumed a new and vigorous life. But it was restricted to newspaper and magazine articles and to popular books; the strictly scientific journals, for some reason, did not touch the subject. If other than amateur observers secretly hunted for the Second Moon, they kept it a secret. After a period of talk, interest in the Second Moon seemed to recede again.

BUT then, in 1877, the American astronomer Asaph Hall announced his discovery of the two tiny moons of Mars. Their existence had not been established by calculation previous to their actual discovery, but, strangely enough, Swift in "Gulliver's Travels" had asserted that Mars must have two moons. His "theory" was that Mercury was the Sun's moon, Venus then had none, Earth one, and Mars must necessarily have two! While astronomers had never been impressed by this logic and, even after the actual discovery, hardly cared about the literary implications, they now had proof that diminutive moons of only a few miles in diameter did exist, which made Petit's *"Lune No. 2"* appear more likely.

Unfortunately, nothing even remotely suggesting a Second Moon had ever been observed, although the power of astronomical instruments had increased very much since Petit made his calculations and although systematic surveys of the heavens were under progress. Still there were two possibilities. One was that Earth had only one moon, the other, that the Second Moon did actually exist but remained invisible, due to peculiarities of its orbit.

It was comparatively easy to find reasons why it could not be seen. First, it was of small size, smaller even than the moons of Mars—say, only a mile or so in diameter. Second, it probably had a low albedo, so that it would be hard to detect even if the astronomer knew where to look for it. Finally, it must have an elusive orbit. Petit had simply suggested a high speed and comparative nearness; in fact, with 200 minutes for one complete revolution at the distance assumed—not quite 8,700 miles from the center of the Earth—its speed amounted to approximately five miles per second—expressed in modern terms, it was assumed to move with "circular velocity."

But circular velocity permits more than one orbit and while Petit had chosen one that would make it hard to see, because it would move too quickly through the field of vision of a telescope, another school of thought culti-

* Not Verne's mistake, but the result of an erroneous report that then circulated. Actually a second moon of Neptune has not been discovered yet. It might be said, however, that it would be impossible to determine, even approximately, the orbit of a body in space from a few moments of observation.

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in trying this business out. You can measure the possibilities and not be out a dollar. *If you are looking for a business that is not overcrowded*—a business that is just coming into its own—on the upgrade, instead of the downgrade—a business that offers the buyer relief from a burdensome, but unavoidable expense—a business that has a prospect practically in every office, store, or factory into which you can set foot—regardless of size—*that is a necessity* but does not have any price cutting to contend with as other necessities do—that because you control the sales in exclusive territory is your own business—*that pays more on some individual sales than many men make in a week and sometimes in a month's time*—if such a business looks as if it is worth investigating, *get in touch with us at once* for the rights in your territory—don't delay—because the chances are that if you do wait, someone else will have written to us in the meantime—and if it turns out that you were the better man—we'd both be sorry. So for convenience, *use the coupon below*—but send it right away—or wire if you wish. But do it now. *Address*

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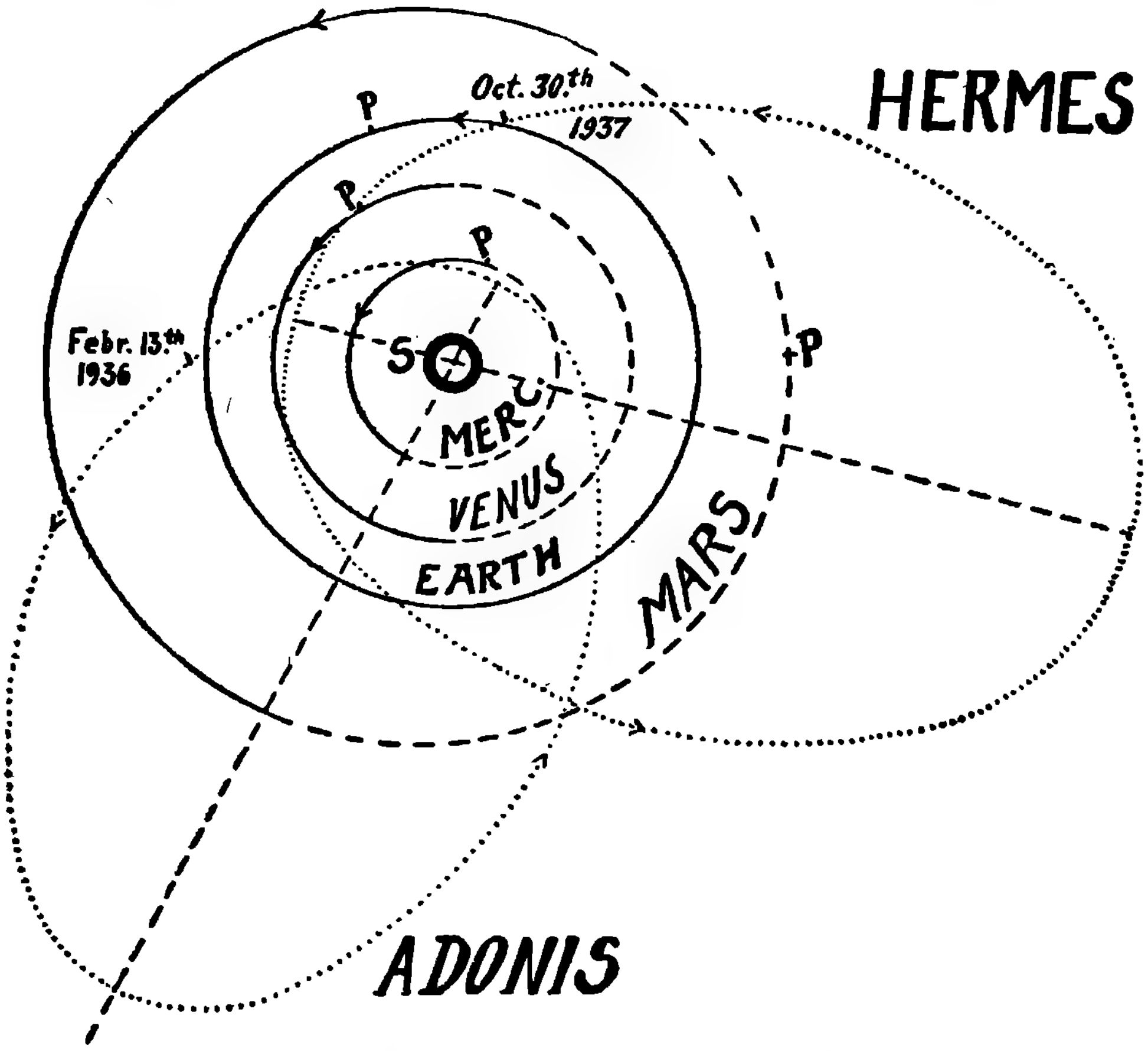
Fig. 1. Orbits of two of the close-approach asteroids with their points of nearest approach marked. Most of the separation of the Earth and the asteroid was not, however, in a direction the orbital motions of the planets would cover, but at right angles to the plane of the ecliptic, in no more danger of collision than an automobile passing over a bridge at the same time a train passes under it.



vated the idea of a satellite that apparently would not move at all. If the distance were 22,440 miles above the surface of Earth—or 26,426 miles from its center—the Second Moon would circle once in twenty-four hours. Which means that it would remain above the same point of Earth as if resting on top of a tower of that height. Such a moon would be very hard to see.

During the day it would hide in the light of the daylight sky, and during most of the night it would hide in Earth's shadow, in a nightly occurring eclipse of many hours' duration. If the orbit were slightly tilted "transits" across the Moon or the Sun would be exceedingly rare—if occurring at all. To see it best during the short time at dusk or dawn when it emerges from the shadow of the Earth before the sky is too bright, one would have to be in the vicinity of the point above which it hovers. This might happen to be the middle of the Pacific Ocean or inner Asia or even America which, at that

time, did not yet have the large observatories for which it is now famous.

The observing astronomers well realized the truth in the assertions of their more theoretically inclined colleagues. Although the chance for success was small, occasionally the Second Moon was searched for—usually by amateurs—but every attempt proved fruitless so that it was finally given up as a bad job. Not even the photographic surveys revealed suspicious objects. While it could not be said with absolute certainty that there was no Second Moon, the chances for its actual existence had become small indeed. What had started out with a daring prophecy, and had been strengthened with so many brilliant ideas and analogies, ended in general disappointment for all but those that had been skeptical from the outset. Gradually all hope for the discovery of the Second Moon was put to sleep.

AGAIN it seemed as if the story had reached its end. And again it was revived by a new discovery. On August 13, 1898, the astronomer Witt in Berlin examined a routine photograph of the sky. A faint line at once caught his attention; he realized that he had photographed an asteroid. It remained to be seen whether it was a new one or one of the four hundred already known. Witt is said to have thought of Johannes Kepler while measuring the plate.

Kepler had been the first to notice that Mars and Jupiter were much farther apart than they should be if there was any mathematical harmony in the Solar System. Their distances were so extraordinary that they made him start the somewhat strange business of "inventing" planets. In his "Mysterium Cosmographicum" (1596) you can find the sentence: *"Inter Jovem et Martem planetam interposui."* Translated: "Between Jupiter and Mars I put a planet."

Kepler would be much surprised, Witt thought, if he could learn that there was not one planet in that gap, but a few hundred of them.

But it was Witt who was more surprised when the calculations were finished. What he had found was a new asteroid, without doubt, but it did *not* move between Mars and Jupiter. Most of its orbit was situated between the orbits of Mars and Earth! Whereupon Witt broke a well-established astronomical rule.

When the Italian astronomer Piazzi discovered the first planetoid—as the asteroids should be called—during the New Year's night of 1801—he had observed only because that night offered a good opportunity to correct a printing error in an astronomical catalogue—he had named it Ceres. The physician Olbers in Bremen, who found the second asteroid one year later, had named it Pallas. Harding in Lilienthal had found a third in 1804 and named it Juno. Olbers added Vesta in 1807—all the names given to the asteroids were female names. The tradition thus started was maintained rigidly for all the 322 asteroids that were caught till 1891 when photographic planet hunting was introduced.

Witt broke the tradition. He named his new asteroid Eros to show even in the name that it behaved differently from all the "females" between Mars and Jupiter. Soon after, another asteroid was found that had an orbit outside the asteroid belt, crossed the orbit of Jupiter and traveled outward in the Solar System. Achilles became its name; a new tradition was started, that of giving male names to those asteroids that ventured across the orbits of one of the larger planets. It soon transpired that Achilles was only one of a group of half a dozen or more that travel in orbits similar to his; they are now known as the "Troy Group," because they all received names of heroes connected with the Battle of Troy.

That the orbits of all these "male"

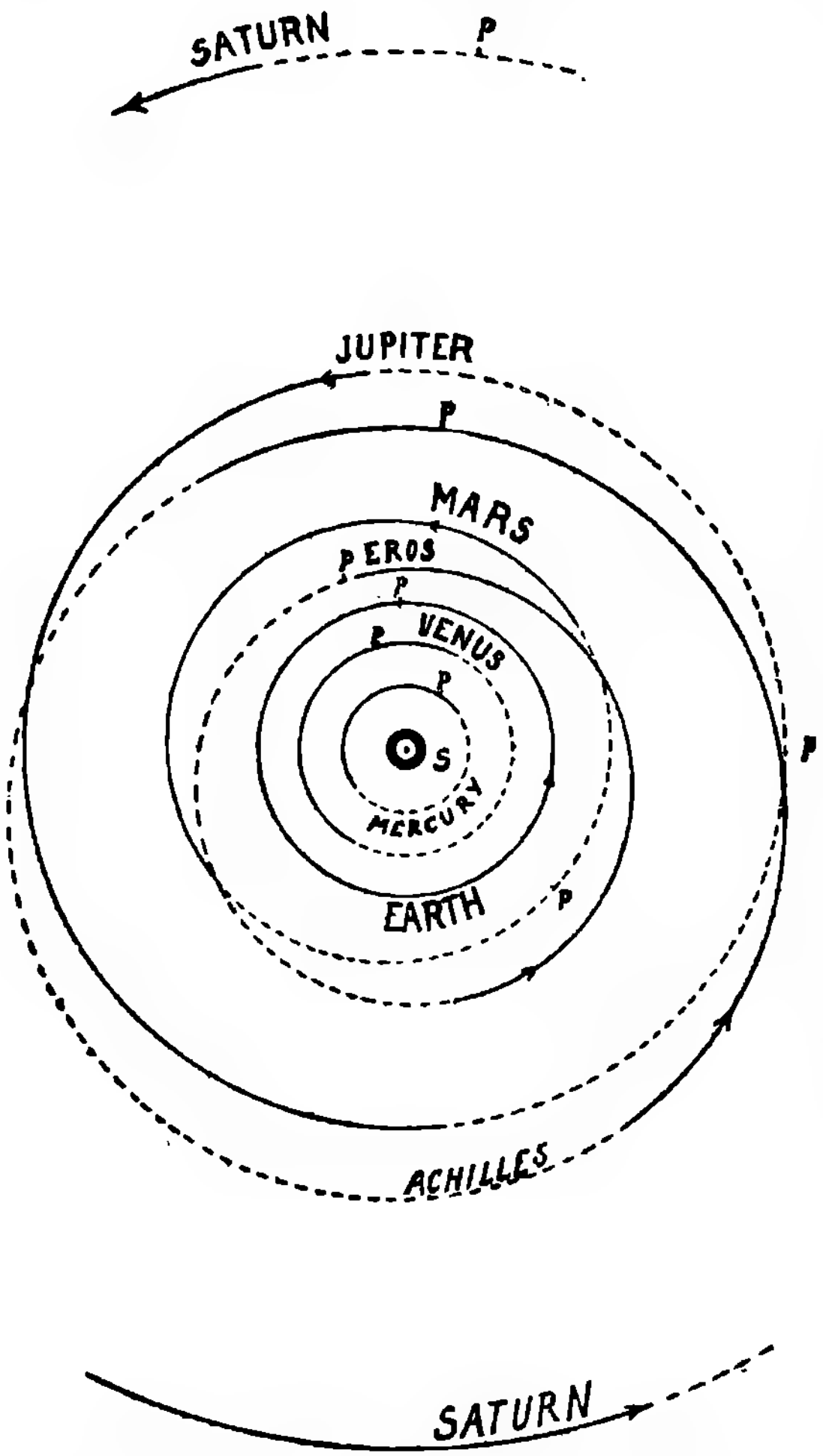


Fig. 2. Orbits of the planets and "male" asteroids, showing the portions of the orbits "above" and "below" the plane of the ecliptic. It will be seen that Jupiter and Achilles will not collide, for at the points where their orbits seemingly cross, one is above the plane, while the other is below.

asteroids crossed the orbit of at least one major planet and usually approached the orbit of another one gave rise to a new problem. If asteroid and planet actually met on those points of their orbits where they were closest together, something would change. There was no danger of an actual collision, since the orbits never crossed like crossroads but always in the manner of a road and a bridge—i. e., at different levels—but that did not eliminate mutual attraction. Changes in orbit were bound to happen, and since there was such a difference in size—all of the male asteroids proved to be small, even tiny—the change would affect mainly the orbit of the asteroid. Could the change be so profound that the larger planet thus acquired a new moon?

Checking the multitude of asteroid orbits known—Achilles was already No. 588—astronomers found that something did happen to asteroids with unfortunate orbits. The asteroid belt itself is not unbroken; it shows a number of very marked gaps, zones unoccupied by asteroids although they cluster thickly not far from these zones. The three most important gaps are caused by Jupiter as can be easily proved. Jupiter's movement across the sky amounts to 300 seconds of arc in twenty-four hours. Mars' movement is 1,887 seconds of arc; the movements of the asteroids assume practically any value within those limits. But at the zone where the daily movement would be 600 seconds of arc, there are no asteroids in space. An equally wide gap is open in the zone where the daily movement would be 900 seconds of arc.

Only one miserable little asteroid is still swinging there in unpleasant loneliness, probably subject to the fate of being thrown out of its orbit one day by Jupiter's influence that adds up every time they pass. Even the zone near 750 seconds of arc, two and a half times Jupiter's daily movement, is almost empty. But strangely enough there are no less than ten asteroids in Jupiter's own orbit, moving with the same velocity as the giant of our

Solar System. But they keep on the other side of the orbit, always forming triangles with Jupiter and the Sun and never approaching closer to Jupiter than they could approach the Sun. One wonders whether they might have revolved in one of the three gaps in former times, but managed to avoid becoming moons of Jupiter, although they had to yield to its gravity.

Some of the missing asteroids are certainly known to us as moons of Jupiter, although possibly not all of Jupiter's seven lesser moons are former asteroids. And, while no place in the asteroid belt can be assigned to Phobos and Deimos, it is for many reasons probable that they, too, were captured.

Mars could do so because its own orbit is not only close to the asteroid belt, but also—and more important—because the orbital velocities of Mars and of the innermost asteroids do not differ very greatly.

All this makes the question very obvious whether Earth, even if it does not possess a Second Moon at present, might one day capture one of the asteroids and *make* it a moon.

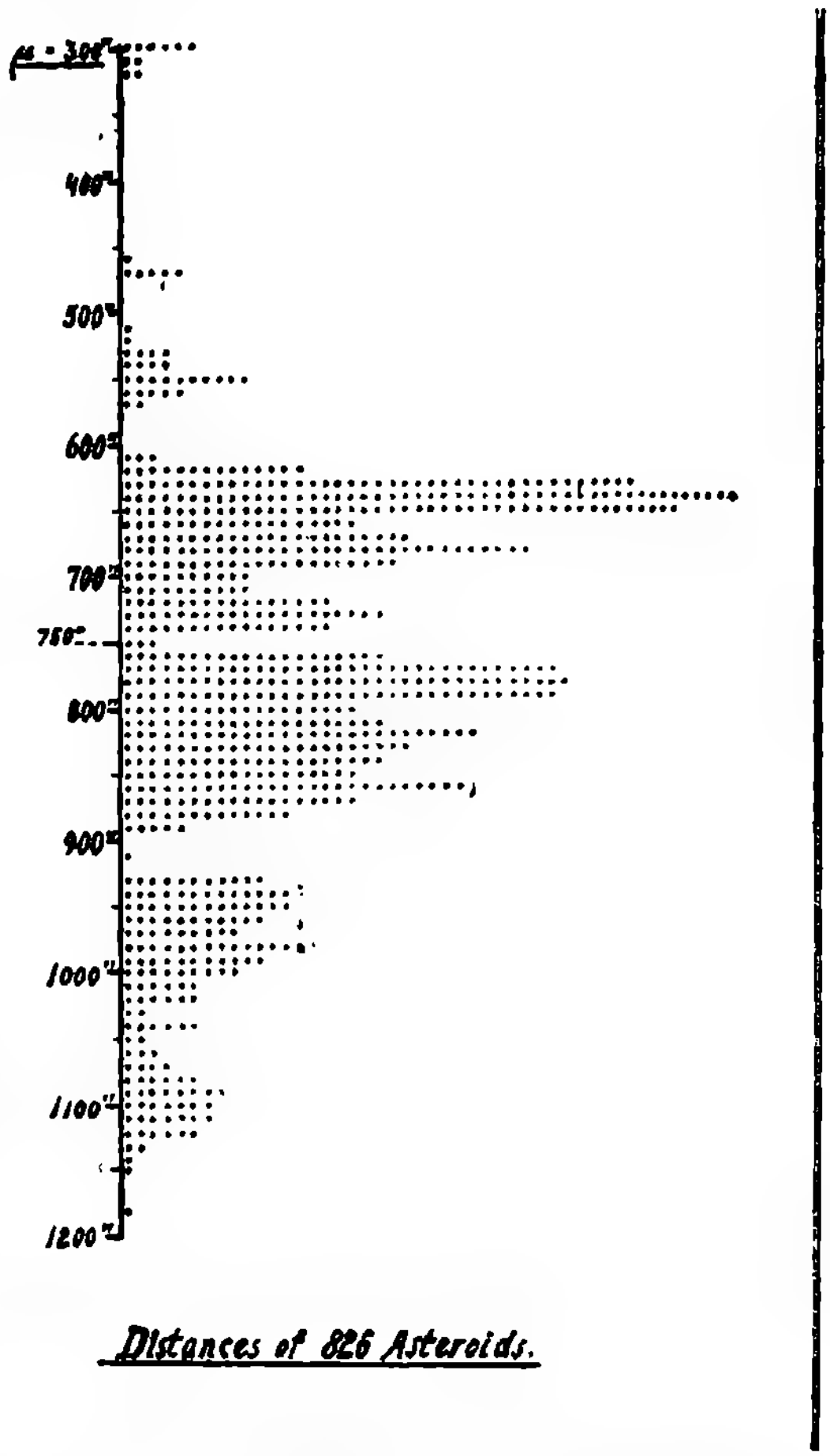


Fig. 3. Distribution of the asteroids, showing the strong concentrations, and the evidences of powerful disturbing forces at work causing blank spaces at regular intervals.

IT IS one of the latest astronomical discoveries that there exists a group of male asteroids on our side of the asteroid belt that corresponds to the "Troy Group" on the other side. The latest member of this group—though in all probability not the last one—is "Object Reinmut 1937," now named Hermes, discovered by Reinmuth in Heidelberg on October 28, 1937. Before that Delporte in Uccle near Brussels had found his "1936 CA"—now named Adonis—on February 12, 1936. Two others of these asteroids are Apollo, discovered by Reinmuth on April 24, 1932, and Amor, discovered only a few weeks earlier—on March 13, 1932—by Delporte.

Most of them can come closer to Earth than any other heavenly body, and some of them did approach closer than even comets ever did. When Adonis was found its distance was seen and one half million miles, but that was after it had passed Earth, at a distance of only one and four tenths million miles. Hermes had approached as close as 400,000 miles—roughly twice the distance of the Moon—but its orbit is such that it can approach to 220,000 miles, even closer than the Moon.

What beautiful arguments would have been at the disposal of Monsieur Petit and followers if the various "Objects Reinmuth" and "Objects Delporte" had been known to them. They fulfill at least two of their conditions for a second undetectable moon. They are of very small size and their albedo is low. All they had to do was to get into an "orbit of elusiveness" around Earth. Whether one ever did is, of course, impossible to say. But the question is fairly well answered if it can be determined whether it *could* get into such an orbit.

The answer is *no*.

Earth's gravity, expressed in terms of velocity imparted to a body falling undisturbed from an infinite distance, amounts to seven miles per second. This is the famous "velocity of escape" or "velocity of liberation." Anything moving faster than seven miles per second cannot be caught by our planet. But Adonis, when closest to Earth, moved with a velocity of seventeen miles per second relative to Earth—to the Sun with twenty-three miles per second. It would have been too fast even if it had almost touched Mount Everest. At the average distance of the Moon its velocity should not have exceeded 0.9 miles per second, and at the actual distance of its closest approach it should not have been more than about 1,600 feet per second. Adonis was only about thirty times too fast!

Hermes can come closer than the Moon, but its velocity relative to the Earth would then be twelve miles per second. All that Earth's gravity could accomplish during the last meeting was to change its orbit by not quite twenty minutes of arc, to draw it almost exactly 1,000 miles closer than it would have passed the orbit of Earth if our planet had been somewhere else and to make it pass fourteen minutes ahead of time.

These figures prove that Earth will never succeed in capturing one of the inner group of male asteroids, and that it never did succeed in all geological history. Such a statement sounds doubly strange if we remember that astronomers have estimated that at least one small asteroid comes as close as, say, three million miles—or less—every single year.

It is somewhat easier to believe that Earth never succeeded, if it is remembered that Venus never succeeded, either. Venus' mass is almost the same as Earth's and as far as position in space is concerned, Venus' chances are not much worse. If there were such a possibility at all, Venus should have succeeded as well as Earth. We know that our planet is two billion years old, and we can surmise that the others are not much younger. There was time enough. But it did not happen, because if Venus had a small moon we would know it. All the excuses furnished for the invisibility of Earth's hypothetical Second Moon would not hold true for an observer on another planet. If Venus had a small moon invisible to the Venusians, it would not be invisible to astronomers on Earth.

I might add for the sake of completeness that Venus was once believed to have a moon. The elder Cassini claimed to have seen it in 1686, and a few others did the same. But since 1800 no trace of a moon of Venus was ever observed and we have to conclude that Cassini and his followers mistook stars in the vicinity of Venus for a moon.

PROCEEDING on purely theoretical grounds one might ask whether the inner planets could not possibly achieve through co-operation what they cannot accomplish in individual effort. Could not Mars, that has the best opportunities of all of them, change the orbit of a female asteroid in such a way that it becomes a male asteroid which is further influenced by Earth and then passed on to Venus. Venus then might add

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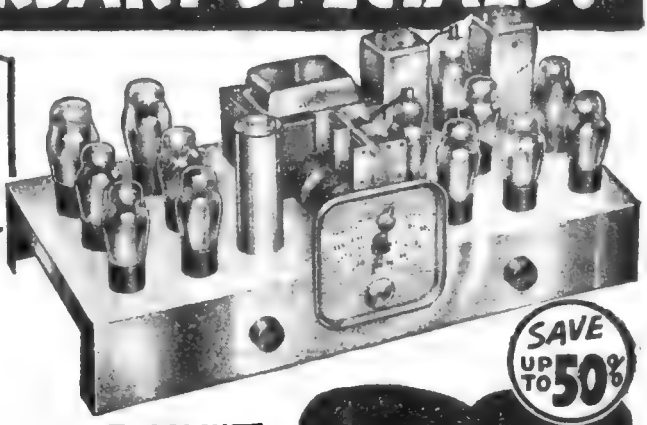

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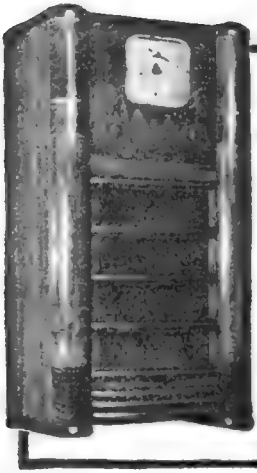

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some more influence and change its orbit in such a way that the asteroid has its aphelion near the orbit of Earth. Then the velocities of Earth and of the asteroid in aphelion would almost match so that Earth can complete the job at the next opportunity. Well, such an addition of influences is conceivable, but the chances that it actually happens are less than one in a hundred million. Besides, it never did happen yet. And furthermore it seems that in the cases of the known male asteroids the influences of the larger powers have a way of canceling each other out that is most promising for the continued independence of the smaller worlds.

If there were some stronger brake for the speeds of the small worlds, things might be different. What would happen if an asteroid actually grazed Earth's or Venus' atmosphere? That would certainly reduce the velocity to a considerable extent and give gravity a chance to work, especially since the asteroid would then be very close.

Fact is that grazing the atmosphere of Earth or Venus would terminate the career of the asteroid in the majority of all cases, but it is very improbable that a new career as a moon would follow. If the grazing does not reduce the speed below the velocity of liberation, the asteroid would simply proceed, although in a highly changed and crippled orbit. In that case it *might* be captured later by the same or another planet. Perhaps! That slight possibility applies only to a grazing that takes place—generally speaking—when the asteroid is returning from its perihelion near the Sun and outward bound in the Solar System. If it grazed on the inward-bound trip, the result might well be that the asteroids would fall into the Sun.

But if the grazing is more effective and the asteroid's speed is reduced to less than the velocity of liberation of the planet in question, the end of the asteroid is only a matter of hours—days at best. The small body would then acquire an elliptical orbit around the planet, an orbit with a "perihelion" in the atmosphere of the planet, a bit be-

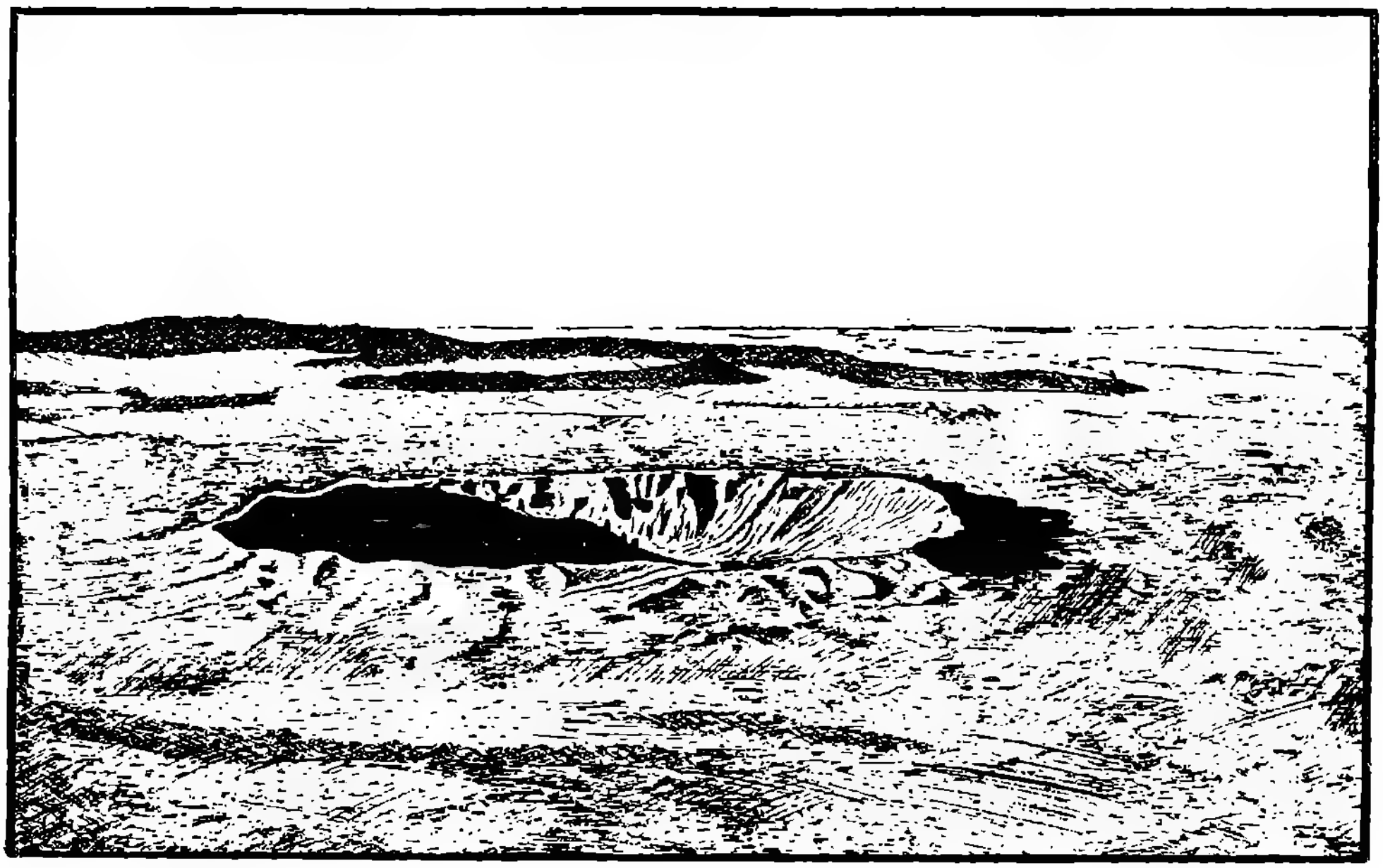

Fig. 4. Monument to a might-have-been moon. Meteor Crater, near Winslow, Arizona.

low the deepest point it had reached. Then, after completing one revolution, the velocity of the asteroid would again be reduced, its elliptical orbit would become smaller and the "perihelion" would still drop lower into the atmosphere. After two or three revolutions the speed would be reduced to "circular velocity"—for Earth, five miles per second—and the asteroid would assume a circular orbit *completely inside the atmosphere.* It is exactly the same thing as that worked out as "landing maneuvers for spaceships" by Dr. Walter Hohmann. If the asteroid had run into Earth from the outset, its life would have been only twenty-four hours shorter.

All this sums up to the conclusion that only those planets close to the asteroid belt, Mars and Jupiter, had and still have a chance to acquire new moons from that almost inexhausible quarry of cosmic material. Jupiter has, of course, the better chance, because it is so much larger. But even small Mars could do it twice on account of its proximity and the resulting low relative velocities. Earth and Venus, although larger, are bound to be unsuccessful because the velocities do not match closely enough.

For this reason it is also extremely unlikely that our moon—meaning Luna—is a captured planet as some astronomers liked to think. But Luna is interesting in this connection for another reason. Even to observers with small telescopes it shows a strange formation. It is located in the mountain chain, designated as the Lunar Alps, and goes under the name of the Great Valley. Although not all experts agree that it was caused by an asteroid grazing Luna's surface, it is generally admitted that it looks as if it originated that way. The speed of the asteroid was apparently not reduced enough to become less than the rather small escape velocity of the Moon—one and one half miles per second—else we should be able to see additional tracks of the same cosmic projectile. That particular asteroid is probably still in space and independent; the chances for capturing one inside the orbit of Mars, where the game is fast and few, are too small.

Another fate is much more likely, the one experienced by the male asteroid that was *almost* caught by Earth. That was between 10,000 and 50,000 years ago, at any event before people built telescopes and gave names to large and small planets. As has been said, Earth succeeded almost, but not completely. The luckless asteroid must have grazed the atmosphere rather deeply and soon after it ceased to be. It died in America and received a fitting burial mound, the biggest and most impressive on Earth. It can still be visited by anybody who cares to go there. The "mound" is not far from Winslow, Arizona: the spot is called "Meteor Crater."

Beginning next month—"There Ain't No Such!" L. Sprague de Camp proves Nature can think up screwier animals than the wildest science-fictioneer—and make 'em work!

BRASS TACKS

"Gray Lensman" gets two covers—and I think Schneeman's illustrations prove he merited the chance to do it.

Dear Mr. Campbell:

News from the fan magazines give me several things to thank you for at the start of this letter. Hurrah for you and Dr. Smith. By all means, give the "Gray Lensman" two covers, or even three covers, but please, I implore you, let Wesso illustrate it. Schneeman is good, very good, and he did a grand job on "The Morons" —incidentally, the best of the June issue—but Wesso is the better artist and I'd like to see him as he was in "Galactic Patrol."

Thanks for getting Finlay to do a cover for you, though he really belongs in *Unknown.* Thanks also for the news that you are abolishing book-jackets for the short stories. They're grand on the longer tales and absolutely necessary on the serials, but superfluous on the shorts. More of the "past, present, and future" from the facile pen of Nat Schachner?

Now for my rating on the June issue. "The Morons" takes first place, "Pressure" second, "Hermit of Mars" third, "When the Future Does" fourth, "Done in Oil" fifth, and Williamson's last. This last Legion story of J. W.'s doesn't come anywhere near the level set by the "Cometeers." The cover was a honey, but it *was not s-f!* The articles were both swell and made up for the lack in an earlier issue.

Let Rogers do Dr. Smith's covers, but only if he can do as nice a piece of work as he did last February—Charles W. Jarvis, 2097 Iglehart Avenue, St. Paul, Minnesota.

We don't hold out. "Gray Lensman" is here! And Uranus cover is coming—perhaps the most beautiful of the series!

Dear Mr. Campbell:

About five years have passed since I last wrote, so I guess it's about time to give you a few more opinions about Astounding, the best science-fiction magazine on the market. I'm sure you're not forgetting that the forthcoming January number will mark Astounding's tenth anniversary, and I'm hoping you're planning something very special. I have a suspicion that you're saving Smith's "Gray Lensman" for it. Perhaps —but it would suit me better if you'd have a nice Williamson or John Taine masterpiece, instead.

Right now, I'd like to nominate "The Legion of Time" as the best story of 1938, and one of the very best Jack ever wrote. Try to get others from him equally as good. Haven't read "Galactic Patrol" yet. And I hope you won't mind, Editor Campbell, when I tell you that "The Mightiest Machine" is the only story in Astounding which I've tackled several times, but haven't waded through the first part as yet. Clifford Simak's "Cosmic Engineers" is the best he's done. While "One Against the Legion" was enjoyable, it wasn't as good as some other Williamson stories.

Wouldn't it be an appropriate and sentimental idea to have the anniversary cover by Wesso, whom you seem to have dropped from the cover? He did the first one, you know, and in fact, all the covers for the old magazine. The Astronomical color-plates meet with my complete approval, and Schneeman's "Saturn" was awfully good. There's an article in the current *National Geographic,* which you've probably seen, which might give you some help or ideas for the covers. A couple of the illustrations are remarkably like ours. About the only planet covers you have left to do, with any accuracy, seem to me to be Terra from Luna, and Luna from Terra. Yes? When does the next come up?

So, this is how the ideal number looks to me. An Astronomical cover, Earth seen from the Moon, done by Wesso, and illustrating a scene from "Gray Lensman." Stories by Taine Williamson, and other favorites. Smooth paper throughout—half of it is smooth now. I know, because I counted. Interior drawings by Wesso, Schneeman, Rogers, Finlay and Robert A. Graef. Sounds good, doesn't it?

All this may be a pretty large order, but please think it over, before you toss aside this letter, for it will be a long time before I write again, and I'd like my suggestion to be of some help to you in improving the magazine.

Rogers' cover for "Crucible of Power" was the most tasteful and distinguished and artistically satisfying I have ever seen. When is he coming up again? Make it soon. So, remember now, drop Gladney completely—let him go back to *The Shadow* and use Wesso, Schneeman, Rogers and Graeff on the cover. Please.—Francis Harry, 1700 North Main, Salisbury, North Carolina.,

De Camp has been busy doing novels in Unknown. He'll be back with a short in Astounding soon.

Dear Mr. Campbell:

With a perfect July issue, Astounding continues to show its heels to all competitors. The stories were among the finest ever presented in "our mag." Brass Tacks got a new lease on life, while Graves Gladney's great cover for "The Black Destroyer" will probably make s-f history.

The stories were all good science-fiction, my personal favorites being, in the order mentioned: "Black Destroyer," "Trends," Lightship, Ho!" and "The City of Cosmic Rays." Not as good as the above were, "Greater Than Gods" and "When the Half Gods Go—" Inferior was Rocklynne's short story, "The Moth." Both the science articles were great, especially Ley's.

There is still room for improvement in Astounding. For example: Wesso has been neglected something awful on the covers, as well as in the inside illustrations. Sure! Graves Gladney is good, darned good, but it's absurd to suppose that he could replace Wesso permanently. Then, there's Dold. Not as great as Wesso, Paul, Schneeman or Finlay; Dold is certainly the superior of Gilmore, Kramer, Orban. So get Elliott back, asd remember to give Wesso a lot more to do, not forgetting Finlay and Schneeman.

Another thing. When does L. Sprague de Camp return? Everything he has ever written has been darned good reading. Of course, I'd prefer a Johnny Black yarn, but anything by de Camp would be plenty acceptable. May I entertain hopes?—Stanley Wells, 235 Noe Street, San Francisco, California.

Articles are rated in the Laboratory only when they break records. "Gray Lensman" is not cut.

Dear Mr. Campbell:

Here is another vote for the Analytical Laboratory with various comments thrown in.

"Greater than Gods." This story "clicked" with me solidly. C. L. Moore really turned out a great piece of work on this one.

"Black Destroyer." This yarn, written from a new angle was most refreshing as a change from the cut-and-dried run of alien menace yarns.

"City of the Cosmic Rays." Schachner's Past, Present and Future stories should run more often. However, unlike the Professor Jameson stories, this series should not keep on for years. Another story should finish it up.

"Trends." I am glad to see Isaac Asimov writing such swell yarns. His style in this story shows a great improvement over his former tales.

"When the Half Gods Go—" A. R. Long has turned out good yarns for some time now, and this is no exception.

"The Moth" and "Lightship, Ho!" follow in order. Even though they are last it does not mean that they are not top-notch stories. They *are*. However, when an issue such as this, with nary a story falling below the "average" rating, and most in the "superior" category arrives, it makes a real headache for the well-meaning and perplexed reader to list them in order of merit.

You made a mistake on this cover. I do not care especially for Gladney and this caricature of a cover lowered my estimate of him several notches. I suppose it is useless to ask for Paul but, nevertheless, consider this as a request for him. Second best is Wesso whom I believe superior to any now illustrating for you. Frew is *bad*. Orban's work is inconsistent. Some quite acceptable and some horrible. Schneeman has improved unbelievably in the past few years.

I believe you should bar articles and serials from the Analytical Laboratory. After all, it does confuse the estimate of complete stories in an issue. At least the articles.

Please do not cut "Gray Lensman" so much that it loses its literary value. When Dr. Smith writes a novel we don't care how long it takes to conclude.

As long as you maintain the standard of the

July issue you will continue on the top of the heap—and what heap!—D. P. Bellaire, 684 Royce Street, Altadena, California.

Don A. Stuart's last story is in the current Unknown.

Dear Mr. Campbell:

This is not the letter of a crank - I am writing it merely in the hope that I am adding my voice to that of many other fans.

You are a science-fictionist of the old school and, no doubt, realize the importance of the art work in a science-fiction magazine. You know how much it helps to get the reader in the atmosphere of the story. A *good* illustration imparts to the vision a great deal of the power and depth of the author's work. And you, as an author, must understand how necessary this is to the enjoyment of the whole.

Now, what I am getting at is this: the recent changes in the art work and the artists have destroyed that grand old feeling that comes upon the sight of each new drawing. The new type is an illustration—a suggestion of what is to come—but that *is* all. They all seem flat and too very insignificant. These new artists don't help the story at all, and all too often actually detract from it, with their gruesome figures and amateurish attempts at machines and spaceships and all that true science-fiction brings out.

To see what I mean, it is necessary to compare the new with the old. Take that first drawing for the fourth installment of your "Mightiest Machine"—March, 1935. It was by Dold in his prime, and did everything to further increase the enjoyment of that great epic. Compare that illustration with any of those being done today by the new artists. It has everything- these have nothing.

Understand, I am not holding you responsible for this decrease. I realize that the art work is probably not in your hands, but I think you might use your influence to get us the real, science-fiction drawing again instead of these "adventure, mystery, detective" blotches. Try to use Dold, Brown, Schneeman, Wesso -for these men have the technique down to perfection. I forgot to include Paul, too. He, with the above, is perfection.

I have been reading and collecting science-fiction for nearly ten years and I have become utterly absorbed with this literature. This accounts for my fervent plea for real art work.

Your stories and make up are, of course, the best in the field. We could still stand a quarterly, but that is probably a fantastic hope. And now that I am finished with my windy pleas, I will give my impressions.

Continue with your fine articles with more on astronomy and space flight such as those of Willy Ley. Have more tales by Don A. Stuart, Nat Schachner, Jack Williamson and all the other old-timers. Let's hope that E. E. Smith will soon be with us again. Everything in the magazine is way above the level of the others on the market and the only thing that needs improvement is, as I said, the illustrations. Just try to model the drawings after that 1935 and 1936 period, when they were the best in the history of the magazine.

It has taken this recent deterioration to snap me out of my ten year silence, but watch out now for I will be sending my opinions of stories and such.—Garrett E. Leeman, 5528 Michigan, Kansas City, Missouri.

Malcolm Jameson plans to expand on Ley's ballistics!

Dear Mr. Campbell:

I regret to have to give Astounding Stories a very good rating for the August, 1939, issue. I repeat, I regret, because it is very difficult to keep up such a high standard as Astounding has been setting for the past six months. I am afraid that I will be disappointed one of these issues—although I know that you will do everything to prevent such a catastrophe. Now to business:

Cover—good. It strikes a note of action and force. I like the contrasting reds and darker colors.

Your little editorials are quite interesting—in spite of the fact that sometimes I do not always agree. However, this month we agree.

"General Swamp, C. I. C." Quite a good and logical story—parallels the American Revolution. Your characters are well drawn, and I am glad to see the individualism shown, for it is passing out in America now. Of course, it is harder to fight a war with people who are free individuals—as we found out in 1776.

"The Luck of Ignatz"—A good character. I should like to see more of this character.

"The Blue Giraffe"—Humor can be used well in s-f, and de Camp handles it best of any that I have seen.

"Pleasure Trove"—The type of story that made old Astounding under Clayton liked—scientales with a punch. Thanks for the breathing spell from the heavy stuff.

"Heavy Planet"—Good. A logical and well-handled situation.

"Life-Line—Very plausible and better on the second reading. The doctor didn't completely believe his own theory and proof until he failed to save the young couple—then he knew that his own time was about up and he couldn't change the future. That was cleverly put in the story.

"Stowaway"—Fairly good story and a good poke of fun at Earthlings.

"An Ultimatum from Mars"—the best of Cummings that I have seen in a long time.

"Space War"—Fine. Willy Ley sure knows his engineering and some ballistics. The article was the best of its type for some time. He is dead right—guns are going to be really tough to handle in free space. The trouble is in hitting the object—a whole new science of ballistics will have to be worked out—something like the multiple body problem on a small scale.

Tell Ley that rays might be safer—if they are developed on a large scale due to their spreading—for space around a battle will be uninhabitable for long distances due to unexploded bombs, et cetera. Of course, the h. e. shells will travel far away if they don't hit.

Inside Illustrations—I still like them O. K.

General make-up was O. K. So you see why I regret to have to give it such a good rating—for can you repeat next month? I hope so.—Thomas S. Gardner, P. O. Box 802, Kingsport, Tennessee.

The present-day conditions of the magazine business are so highly competitive that the large-size quarterly could not pay.

Dear Sir:

You are to be doubly congratulated for your splendid work with "Astounding." First, because you have made it the top-notch magazine of the science-fiction field—present or past; second, and more important by far, because you are abetting the evolution of s-f into a recognized and respected literature. The contribution made by Astounding, under your editorship, toward this latter goal cannot be overestimated. Sensationalism to sobriety, disrepute to distinction, over a period of fourteen years—and progress has never been swifter for our pet avocation than during the past two years.

Science-fiction is indubitably growing up, and I think we can be certain that the future will acclaim it as a leading literature; and, as I have pointed out, Astounding's influence in dignifying science-fiction, in making it plausible, thought-provoking, and scientific, is a major factor in the literature's development. I am sure that you have the gratitude of dyed-in-the-wool readers—as well as the largest circulation!

This afternoon, shortly after purchasing the August Astounding, I heard one of those "man-on-the-street" broadcasts. The interviewer asked spectators the following questions, more or less pertinent to Mars' current opposition: 1. Do you believe there is life on the planet Mars, and if so, what kind of life? 2. Do you believe interplanetary travel will ever be achieved, and if so, will we live to see it? 3. Assuming interplanetary travel to be an accomplished fact, would you be willing to take a chance in the first rocket-flight to Mars?

I wonder how the people of forty years ago would have reacted if called upon to voice an opinion as to the possibility of heavier-than-air flying machines? Would they have called for the wagon, and had the obstreperous questioner incarcerated? Quite possibly.

But the answers to today's questions show more clearly than any academic argument, how the public mind has changed. Ninety per cent of those interviewed thought that life might well exist on Mars, and ten per cent of these pictured such life as resembling the genus homo sapiens. About seventy-five per cent thought spatial travel an eventual certainty, and two or three people claimed it might come "tomorrow"! One lady remarked that she was against interplanetary travel because "it is against the will of God." "Trends," by golly! Perhaps the most surprising result of the interview was the fact that ninety per cent of those questioned declared that they would jump at the chance to hop the first rocketship to Mars! I guess the old spirit of adventure still runs hot in our veins! And nobody can make me believe that science-fiction is not largely responsible for this refreshing outlook!

I want to make a few remarks concerning Astounding's art work. First, don't drop Schneeman! He has one of the finest techniques of any science-fiction artist: personally, I consider him *the best*. If you stop to analyze his work, you will find an easy, flowing style that is very natural and very pleasing. His portrayal of intricate machinery is unsurpassed, as demonstrated by his fine illustration for the science article, "Tools for Brains," in the July issue. Introduce new artists from time to time, but don't abandon your best bet!

Second, a bouquet for W. A. Koll! His line work is beautiful! The second and third illustrations for "Pleasure Trove" look like delicate woodcuts. I hope you will continue to buy his work.

Third, I was somewhat disappointed by Finlay's cover painting. Perhaps I was expecting too much, for the artist's widely publicized name is a force to be reckoned with—it had me visioning hypothetical masterpieces all month long. This month's cover, however, just didn't click.

Thanks for Willy Ley's article on guns. Down with rays! The era of reason and logic in science-fiction sweeps aside the shattered remnants of past delusions.

There is one thing on which I desire information. Is there any possibility in the near future, of an Astounding Quarterly? It must be merely a sentimental attachment I have to the big, juicy quarterlies of old, for I would like nothing better than to see the best s-f magazine come out with one. How about it? Can you at least make a definite statement regarding a quarterly somewhere in your columns? Perhaps in the Brass Tacks department?

Nothing need be said of your choice of stories. You consistently get the best. De Camp is delightful—a past, present, and future master at the art of telling 'em, and making you believe 'em. Del Rey is up and coming. Bond is hilarious and colloquial. Your new authors are seldom disappointing. Treason or no, I look forward to Smith's "Gray Lensman" with utter indifference. But you have few weak points, and many strong points, so more power to you!—Louis Goldstone, Jr., 622 Presidio Avenue, San Francisco, California.

What makes the wheels of Like and Dislike go 'round?

Dear Mr. Campbell:

This letter is dedicated to the proposition that fantasy fiction has bred the most illogical double-track mind in history—that of its readers. On the one hand we have a group of publications that profess to speak in the name of science, and science alone. The element of escape in let-

ters is recognized as fundamental; but it must be buttressed with the expounding of recognized scientific principles, with Einstein as arbiter and prophet. The reader of such magazines as Astounding Science-Fiction is ready, willing, and able to foresee vast improvements in the future of the human race. He is an incurable and narrow-minded optimist, because he believes that whatever will come, will be right; progress go forward. He is close to being a technocratic socialist, believing with the forward march of civilization will come less work and more educated play for the average man, whether he has anything to do with it or not. The science-fictionist disregards submergence of the indivual in the world of today and assumes that the world of tomorrow will have an entirely democratic foundation.

Science and security go hand in hand; the laboratory will yield many more secrets to the inquisitive Earthman and he will inevitably leave the Earth and seek to exploit the marvels of the Moon, and of Sirius. The wealth of the Universe shall be transformed into a storehouse of blessings for all humanity. The past is merely an unfortunate vagary of the time-line. Man can and WILL control the future; he will ultimately make the Universe God's country for God's children.

Thus the science-fictionist.

But we leave the sunlit imagination of the open mind and approach the dark corners of the brain known as the subconscious, containing the unavoidable heritage from the past. We enter the world of shadows, of feeling and fear, of idol-worship, of witches, werewolves, warlocks, of eldritch and ifrit, of ghost and ghoul. We are in the grasp of night. We are in the world unknown.

The slant of *Unknown* is opposite to that of Astounding. What we don't know, *will* hurt us. Superstition goes scientific and that which is scoffed at in science-fiction as the leavings of ignorance in the past is taken out of the closet in the children's playroom. The skeleton is reverently dusted off, examined, and new skin is grafted on. The past is regarded with wide-open, believing eyes and it is believed. Legends and old wives' tales are given the virtues and vices of existence and—we take them at face value. Elements and elves, magicians and miracles, fairy tales and the Arabian Nights, the Bible and the Koran—all were experiences of various segments of the human race!

And all retold with a style combining the wistfulness of Robert Nathan with the mystic profundity of H. P. Lovecraft.

Thus the two fields in fantasy—pseudo-science and rationalism—weirdness given verisimilitude. There is no obvious connection between the two as they stand. BUT—"beauty lies in the eye of the beholder," *chacun a son gout*, and we find that the same individuals flourish in each field! The same readers, the same writers, the same editors!

If you read Astounding Science-Fiction, you're *bound* to get as much kick out of *Unknown!*

I regard this phenomenal fact as proof of the Jekyll-Hyde existence of the mind-soul entity. The Jekyll-science-fictionist stands for experimental truth, for logic, for PROOF. The Hyde-nocturnal-seeker exists in frank fear of the dark in the world of dreams, of Solomon-Sulayman, of witches'-brew, of curses, of Kismet. Robert Louis Stevenson's doomed scientist who flirted with fate is the fanciful prototype of the fantasy fan, the fantasy fashioner, and the fantasy editor.

This double standard of unreal writing, this most happy of hypocrisies is very mysterious to me. Occasionally the two branches of fantasy overlap, as in the theoretical projections of Atlantis and Mu which have just enough historical basis to make them pseudo-scientific subjects and just enough misty background to allow the imagination free rein in concocting scientist-meets-girl situations.

I'm not making fun of anyone when I point out the fact that science and superstition appeal to the same readers, writers, and editors. I read Astounding and relish the triumph of science; I read *Unknown* and relish equally hypotheses that there really are more things on heaven and Earth than are dreamed of in Issac Asimov's philosophy.

I'm only asking—is the reality of the reader's enjoyment of both Astounding Science-Fiction and *Unknown*, explicable in more simple terms than I've used, or is it up to Freud to figure it all out?—Seymour Kapetansky, 1524 Taylor Avenue, Detroit, Michigan.

I wouldn't be too sure human beings wouldn't take over native tongue-twister names. How about "Schenectady," "Hohokus," "Popocatepetl" and the town "Przesmysl" in Carpathia?

Dear Editor:

You will probably be surprised when you finish reading this, but don't let it discourage you; I just feel mean today.

I just finished the August issue of Astounding. My feelings are a mixture of pride, sorrow, anger, and nausea. When I first saw the cover, I thought I had the wrong magazine. Why that particular scene was chosen, I do not know. There were many incidents in the story which would have made a much more interesting and attractive picture. I am squirming with impatience until the next astronomical cover appears. Let's have a view of the Earth from Luna done by Wesso or Schneeman.

"The Luck of Ignatz," was best in my estimation. Del Rey improves with every story.

"Heavy Planet" was good. It reminded me of a grunt-and-groan wrestling match though.

"Life-Line" was as good, if not better than "Heavy Planet." How about more like this?

"Space War." Another homer for Willy Ley! This article showed clear thinking and careful preparation. The guys who kick at articles like this are too ignorant to be reading Astounding.

"Isotope 235" was like a cool breeze after wading through a pile of rubbish. I would have bought Astounding for these two articles alone.

"The Blue Giraffe." An average story, interesting and with a touch of humor. Not as good as de Camp's usual work.

"Stowaway" was fairly good. The "ampie" did not conform with de Camp's "Design for Life" very well. He was amusing though.

"Pleasure Trove." The story of a couple drunken dope-fiends. It ought to be where the two thugs just mentioned belonged—in the garbage can!

General Swamp, C. I. C." The C. I. C. ought to stand for "Certainly Is Corny." After apologizing to Fred Engelhardt, I would like to say that this story is the worst piece of idiocy ever to disgrace our magazine. A probably (?) perfectly good plot was ruined by a mess of swill Engelhardt must have heard in a nursery or an insane asylum. When in doubt as to name, he must have left the space blank and then closed his eyes and banged out the required number of letters at random on the typewriter. After having tried to pronounce words like Arkgonactl and Sungikiki every few lines, I became lost as to the story itself. It sounds like something dreamed after a midnight snack of onion sandwiches and chocolate ice cream. It stands to reason that when places are occupied by human beings, such tongue-twisters will not be used. Names like 'ixite' are sometimes necessary, but an unintelligible babble like the above, no! This story was perfectly nauseating. If part 2 is this bad, I refuse to read it!

By some freak of printing, Brass Tacks was placed in the center of the book. I almost had heart failure when I thought I had reached the end of the magazine, so soon.

The letter by W. B. van Arsdel rubbed my fur the wrong way! I think people are beginning to feel it is their duty to understand the apparatus they come in contact with every day.

I celebrated my fifth year of Astounding in May. The improvement has been tremendous! Let's keep it up.—D. L. Dobbs, 1011-17 Avenue S. E., Minneapolis, Minnesota.

SCIENCE DISCUSSIONS

Malcolm Jameson is one of the country's few real experts on really heavy guns.

Dear Mr. Campbell:

Up to now I have been one of the most inarticulate of your contributors, but Willy Ley's "Space War" in the August Astounding, is like smoke in the nostrils of an old fire-horse—it starts me itching to hop into the ring with him for an unlimited bout where we can hurl back and forth the fascinating facts of ballistics—both interior and exterior—and drag in that other science that utilizes both of them and some other things—Fire-Control. Ordinarily, I approach your science articles with a good deal of deference and with appropriate modesty, but when anybody starts writing about ordnance he is on ground where I think I know my way around. It happens that I spent eight or nine of the best years of my life where ordnance was being designed, manufactured, tested and used—in gun factory and laboratory, at proving grounds and on warships, both in peace and war, and in the field with troops. So if I make bold to comment on Mr. Ley's article, it is because I feel that I am competent to do so.

Not that I mean to imply I have fault to find with it. On the contrary, I am all for him—barring a few minor points. I like his demolition of the heat-gun and ray-screen doctrines, and the way he sails into other fantastic gadgets. I am in thorough accord with his choice of propelled explosives as the most probably final weapon of future warfare. My chief criticism is that he did not go far enough. He tells us what projectiles will do to the hostile ship, but not how to find it and hit it. The problem of finding the enemy and maintaining contact long enough to hit him, considering the stupendous reaches of the void and the colossal speeds involved, seems to me to transcend all other considerations. But then, that is the subject matter for another article entirely.

It occurs to me, however, that readers of Astounding may be interested in some expansion of several of the things Mr. Ley mentions; and also I would like to take issue with him as to one or two of his statements. Merely to list and briefly describe the many known factors that enter into gunnery would require pages, so I will confine myself to a few of those touched on in the article.

He spoke of the retarding effect of the air in the rifle bore ahead of the projectile. I can cite an instance that illustrates that beautifully and it won't be necessary to swamp you with

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graphs, formulae or statistics. When the battleship *Mississippi* went into commission, Dr. Curtis of the physics department of the Bureau of Standards was one of the experts who went with us to Cuba to hold her experimental battery tests. Among other things, he desired to measure muzzle velocity under shipboard conditions. M. V. determination up to that time had been done only at the Proving Ground where it was possible to fire the shell through two successive screens hung in front of the gun.

Dr. Curtis rigged two metallic fingers at the muzzle of the gun, protruding slightly above the bottom of the rifling grooves, and also stretched a wire across the bore opening. These were parts of two electrical circuits, each hooked up to oscillographs. The idea was that the nose of the emerging shell would break the wire, thus interrupting one current, and that the *bourrelet*, or rotating band, would wipe the fingers and complete the circuit of the other, thus producing two wiggles on the oscillograph tracing. He knew, of course, the exact distance from the shell-top to the leading edge of the *bourrelet*.

The first readings were absurdly low and Dr. Curtis correctly guessed that it was because the outrushing air had broken his wire before the shell got there. He put in heavier wire. Then a steel rod. Believe it or not, it was not until he had worked up to an iron bar, of something like ⅜ of an inch by a couple of inches, set edgewise like a girder across the opening, that he found something that would stay there until the projectile emerged. Even at that he had trouble with its fastenings. Some breeze!

I note Mr. Ley's complaint that designers simply do not pay attention to weight unless the question of transport is involved. I assure him he is quite mistaken. If the guns of a battleship could be reduced in weight by so little as five per cent, it would mean the saving of many tons which could well be utilized for other purposes. Actually, other characteristics of the gun being equal, gun weights have steadily declined—due chiefly to improvements in steel-making processes, notably heat treatment. Presumably, the trend will continue as better methods and stronger alloys are found.

The reason for the present weight of guns is stark necessity. It takes a lot of metal to withstand a suddenly applied force of upward of twenty tons to the square inch. When he says that reducing the thickness of gun barrels shortens their service life, he is dead right. It shortens it all right—is likely to cut it down to one terrific and fatal blast. If he had had the opportunity as I had, of seeing many ruptured field guns lying on Southampton dock during 1917, he would not think the factor of safety overstressed.

As to the difference in thickness between a worn-out gun and a new one, it is almost imperceptible to the untrained eye. Gunners keep a careful record of the number of rounds fired and star-gauge their guns often, for that is the only way they can keep track of the erosion. A worn bore, and the wear may not exceed the thickness of this sheet of paper, permits the powder gases to escape past the projectile, thereby seriously reducing its velocity. It also tends to promote wobble in flight.

In the vicinity of the breech not only are the pressures greater, but the temperatures are terrifically high, and I suspect that the lining of the powder chamber and the face of the breech-plug is for a moment in a virtually molten condition. I witnessed a blowback once, through an infinitesimal hairline scratch on the seat of the gas-check seal. It was a brand-new 14" gun under proof and the breech of it was ruined. The gases escaping through that little hole blew the metal out in a fine spray, like butter under a blow torch. Of course, the speed of the leaking gases added vastly to the damage, but it must be hot in there.

I doubt very much whether a strictly non-recoiling gun is possible. The recoil begins much earlier than most people imagine—shortly after the projectile has started moving within the barrel.

In regard to the "optimum" elevation of 45 degrees, I might say that that is the elevation that theoretically gives the maximum range. I have seen heavy guns fired all the way up to fifty degrees, but there is little gain in range

Continued on page 160

IN TIMES TO COME

The installment of "Gray Lensman" running next month will be another husky, man-sized bite of one of the longest science-fiction novels ever written—and, you can now realize—one of the best. This coming installment brings out a totally new phase of both Dr. Smith's writing abilities, and of Kinnison Kimball's make-up. It could almost stand as a long novelette in itself.

It is interesting, and rather unusual, that those who won the high places in the August Astounding—see the Analytical Laboratory below—will be present with shorter material next month. Lester del Rey, No. 1 in August, has the short, "Habit," crowded over from this issue by the length of Dr. Smith's story. Robert Heinlein, who won a second place in the Laboratory with his first story, has another short, "Misfit." And L. Sprague de Camp, who consistently establishes records with his articles, begins a new and fascinating article. "There Ain't No Such!" refers, of course, to animals. If you think the science-fiction authors have imagination, you ought to see the things they could learn from old Mother Nature.

Nature, of course, has had some two billion years to think up screwy beasties, but she certainly hasn't an inactive imagination. Furthermore, she makes 'em work. You know, of course, about the "glass snake" that leaves its wriggling tail behind for pursuers to catch, thus diverting their attention. But how about the animal that leaves *all* his workings behind for the enemy, and flaps off nothing but his skin? And for specialists, we recommend the one that lives in only one type of place, exclusively—the felt mats Germans put under beer-mugs, and no place else!

It's an article relating facts to make a Weinbaum jealous!

THE EDITOR.

THE ANALYTICAL LABORATORY

As intimated above, Lester del Rey's "Luck of Ignatz" took first place in the August issue. The race for places was close all the way down the list; Ley's article "Space War"—which seems to have started a war in Science Discussions, thereby proving its worth as an idea-starter—tied even, in number of points, with "Heavy Planet."

The August issue was unusual in a number of ways. First, it was very well received, with a wide divergence of opinion as to best stories—which means it pretty well suited most—and introduced no less than three first-time writers. Two of the first-timers made the Laboratory; the third, having a serial, is slightly cheated by the number who said they'd wait till it was completed before voting. The line-up at make-up time was:

1.	Luck of Ignatz	Lester del Rey
2.	Life-Line	Robert Heinlein
3.	The Blue Giraffe	L. Sprague de Camp
4.	Stowaway	Nelson S. Bond
5.	Heavy Planet	Lee Gregor

THE EDITOR.

Continued from page 158

after the upper thirties, and a progressively greater loss of control. The famous German long-range gun could only be effective against a target as large as the city of Paris. Hitting somewhere within a ten-mile circle is not an artilleryman's notion of marksmanship.

As to streamlining, that has been tried but is not practicable for several reasons. However, that does not mean that the shape of the shell is unimportant. The "coefficient of form" is an important one; long-pointed shells travel farther than short blunt ones. Armor-piercing projectiles that have to be stubby are equipped with false noses for that reason.

Of course, I realize that all this quibbling is about Earthly conditions and is not very applicable to what happens in the void. I am writing only because it may be of interest to our fans. As to the extension of Space Warfare to take in such matters as scouting, range finding, tracking and spotting, I am very much tempted to break out as an article writer myself. Then Mr. Ley can slip in a new ribbon and do a little sniping of his own.—Malcolm Jameson, 519 West 147th Street, New York, N. Y.

Maybe you can use rays, at that!

Dear Mr. Campbell:

I want to make a few comments about the August number of Astounding.

First point is Willy Ley's article on the weapons of space combat. Frankly, I'll still stick to the flaming rays and scintillating screens; Mr. Ley's argument against them starts off with a bit of a self-contradition. On page 74 he states: "That they (ray projectors) do not exist now is immaterial; science-fiction is not only concerned with things that are, but also with things that might be." And forthwith proceeds to argue them out of existence on the grounds that the equipment necessary to produce them would be so ponderous compared with present-day artillery as to make them impracticable. Come, come, Mr. Ley! Surely, if you admit their scientificational credibility, it won't strain you too much to realize that there is just a possibility that those same projectors might not be either so weak or so sensitive to shaking or jarring as you seem to think.

You say the projector would need a power plant, and "power plants are notoriously heavy." O. K. But it also appears to me that even an unarmed ship might need a fair-sized set of generators just to lift it into space; unless, of course, you insist on limiting the poor writer to the sort of chemical rocket that can be designed today.

You say that the ray generator would be sensitive, "since we have to assume tubes of some kind." Do we, now? Let's try a spot of assuming, and see what sort of power plant and ray projector we can dream up, even without going too far beyond our present scientific knowledge.

Power plant first. Suppose we make it an atomic energy set-up, using the fission of uranium-235 under neutron bombardment. We'll need a source of neutrons to start off that reaction. Cyclotron, perhaps, since you seem to like a heavy power plant; though I think that with U-235 a simple, light, insensitive radioactive source might work as well. A cyclotron would have tubes to go out during an engagement, all right, but we needn't worry about that; we'll just use it to touch off the process at the start, and keep steam up afterward, since the reaction is self-perpetuating. Probably need a direct hit now to put that job out of action.

Ray projector? Well, I suppose we *could* turn the released energy into electricity, to be later transformed into some deadly radiation in a delicate ray generator. It seems to me that a stream of those 200-million-volt atomic nuclei given off by disintegrating uranium, and released in the general direction of the enemy through refractory projectors would be just as deadly and a lot simpler. That question of refractories is a delicate one, I admit; but we'll need them, anyway, for the power plant, so let's not strain at gnats while swallowing camels.

Do I hear an objection from Mr. Ley? "If there is an insulating material that holds out against the energies released at the giving end, it is hard to understand why the same insulator should not be usable to safeguard the hull of the ship that is being rayed."

Same answer as to the question: Why not armor-plate the ship against solid and explosive projectiles from Mr. Ley's heavy artillery? Too heavy; and, perhaps, a whole lot more expensive than even the best nickel-steel armor. But if you insist, I'll make my ship invulnerable to ray attack; only you've got to reciprocate, and turn *yours* into a flying fort, complete with 30-inch plate all round.

This begins to look like stalemate. So let's compromise; fit out our warships of space with both rays and guns, ray screens, insulation, and armor-plate, and see what new forms of deviltry the boys can think up with that equipment.

It should be interesting.—A. Arthur Smith, 131 Aqueduct Street, Welland, Ontario, Canada.

The Egyptians had palm trees, though, and they aren't a temperate zone plant.

Dear Sir:

If I remember rightly, the grammar-school geography stated that the temperate zones are best suited to civilization, the tropics being too hot and the polar regions too cold, et cetera. I have always wondered why most ancient civilizations began in tropical or semitropical regions.

I believe Willy Ley's excellent article, "Ice Age Ahead," explains this to a T. Simply this: These regions which are tropical now were temperate when the civilizations began to develop. In other words, they were just emerging from the ice and therefore were temperate.

It is probable that the decline of those ancient civilizations is due to the fact that the regions ceased to be temperate and became tropical. It got too hot for them, as it were. What do you think?—A. J. Millman, 140 So. Dale Ct., Denver, Colo.

That movement may be merely a short-time variation, though; ice ages mean thousand-year periods.

Dear Mr. Campbell:

In contradiction of Isaac Asimov's letter in the April issue and in confirmation of Mr. Ley's article, "Ice Age Ahead," I wish to say that in a recent article it stated that the north pole ice cap is moving several—or maybe four—inches per year southward!

Isaac Asimov states that during the last fifteen hundred years there has been a general warming up of Mother Earth. This does not mean that it will keep on being warm and never have another ice age. Before the first ice age it was exceedingly hot. History repeats itself, you know.—Robert Meyers, Ridgeley, W. Va.

Somehow, Ley seems to be going for a ride this month! Which shows Ley can really start readers pondering.

Dear Mr. Campbell:

I should like to thank you for the many interesting scientific articles you have been giving to us, your readers, for the past few months. They are quite an improvement over those of seven or eight months ago. Not only are the articles better written, but they are also of better subject-matter; the more practical sciences, such as geology and physics, have been chosen.

I refer especially to the writings of Mr. Ley. He is indeed a versatile fellow. Articles in *Nature*, Astounding, and other magazines. He is indeed a man of all the sciences. In addition, he has a surprising command of English for a foreigner. Please thank Mr. Ley for me for his many excellent articles.

The bulk of this long letter is going to be about Herr Ley's latest article, his "Geography

for Time Travelers," for there are several points upon which I do not agree with the author. These points are:

1. Mr. Ley's Devonian earth. Herr Ley pictures the earth in the Devonian Period as consisting of three great continents, each a level, flat, arid red desert, whose monotony is relieved by nothing. On the whole, this view is not wrong, but it is far from accurate. Deserts were the dominant feature of the landscape, but were not its only feature.

In Europe, we would see a range of rather high mountains running from Ireland to Scotland to Scandinavia. (NOTE: In giving the names of present geographic localities, I am merely taking a short way of saying, 'the land which occupied the position now occupied by—') the Caledonian Mountains, from which sloped southward a broad flat plain, probably desert, but which possessed many short-lived, fresh-water ponds. Evidences of vulcanism would be everywhere: volcanoes, lava flows, etc.

In North America, the time traveler would find the Arcadian Mountains in the Middle Devonian. In Late Devonian times, the traveler would find a great area of thick black soil around New York, which soil has survived until today in the forms of slates and shales.

To repeat myself, the red deserts would be the dominant feature of the landscape, but would not be the only feature. My supposition is that Mr. Ley also realizes this fact, but slightly simplified the situation for clarity.

Incidentally, Mr. Ley allows 350,000,000 years for the time elapsed between the Devonian and the Quaternary. The figure generally accepted in America for this time-stretch is from 260,000,000 to 285,000,000 years. Naturally, geologic dates are disputable. However, in an elementary article such as this, I believe it would be best to stick to the generally accepted American chronology.

2. Herr Ley remarks that the panthalassa probably did not exist in early pre-Cambrian time. In this supposition, I believe him to be correct. It is generally admitted that the Keewatin-Coutchiching complex of Canada is the oldest rock formation known; and this rock is formed of sedimentary materials intermingled with lava flows and layers of volcanic ash. The sedimentary particles composing the rocks must have been eroded from already exposed rocks; hence the panthalassa could not have existed. The great extent of the Keewatin-Coutchiching complex supports this view, for the great amount of material represented could not have come from a few small islands.

3. Mr. Ley remarks that life did not exist upon land during the Cambrian Period, and that the seas were the only abode of life. He should have said *animal* life. For many fossil pteridophyte spores have been found in Cambrian rocks. These plants were comparable to our ferns, and were almost totally land plants. A second refutation of Mr. Ley's statement is seen in the fact that many of the Cambrian rocks are shales, which are generally conceded to need plants for their formation. Furthermore, there is no reason to believe that fungi and bacteria did not inhabit the world at that time.

4. Here is a real error. The author states that the first know glaciation is the rather insignificant Permo-Carboniferous. In this he is wholly wrong, for at least three previous glaciations are accepted by practically all geologists.

For the sake of those of your magazine readers who have no knowledge of geology, I must here disgress, and explain that the presence of glaciation is determined primarily by the presence of tillite, and secondarily by the presence of striations upon either the tillite boulders themselves, or upon the rock floor upon which the tillite rests. There are other criteria, but all are less permanent.

The first glaciation known occurred in the Proterozoic Period, and its tillite is found in the Cobalt division of the Huronian Series in the Canadian Shield. Thick beds of tillite, up to 500 feet thick, rest upon a greatly striated floor. Other tillites of similar antiquity are found in Wyoming, Finland, and Australia.

A possible glaciation may have occurred during the late pre-Cambrian era. This is represented by the Keweenawan tillite-conglomerate of Canada. This rock has not been proved to be tillite. Other doubtful formations of the same age are found in the Scottish Torridan Formation.

During the Lipalian erosional interval, just before the Cambrian Period, another glaciation occurred. In China, tillite beds three to five layers thick, and 400 feet thick, underlie early Cambrian rocks. Similar tillites are found in South Africa and Australia.

Still another glaciation took place during the Devonian Period, just toward its close, and in the Silurian Period, just at its beginning. Its remains are found in Alaska, South Africa, Norway, and Australia.

All of these ice ages are long before the Permo Carboniferous glaciation.

5. A minor error, if error it may be called, Mr. Ley makes the statement that mammals appeared in the Carboniferous in Gondwanaland. I should rather say mammallike reptiles, represented by the Therodonta of South Africa, appeared in the Carboniferous, and became the ancestors of the mammals, who appeared in the early Triassic.

On the whole, I agree with Mr. Ley's ingenious pre-construction of the earth's surface. Naturally, neither of us is able to predict the future, but his map seems entirely reasonable.

Please do not think that I am not satisfied with Mr. Ley's article for I really enjoyed it greatly. All the errors I list are probably differences of interpretation or opinion. On the whole, Ley did a fine job upon a subject hard to popularize. *Schreiben Sie mehr, Herr Ley!*

De Camp's article "Design for Life," is very well written. However, about all he proves is that humans would be nothing but humans. It reminds me of the attempt of the nineteenth century scientist and mathematician to prove that flight was impossible for a lighter than air vessel. We do not know enough about biology to compose any "design for life." E. Franklin, Jamaica Plain, Massachusetts.

From the British Interplanetary Society.

Dear Mr. Campbell

I was very interested to see Schuyler Miller's letter concerning spaceship crews in the July Astounding. As you know, this Society has been working on the subject for several years, and you have already seen our designs for a lunar ship, which were printed in our last *Journal*.

There's no need to have a large crew on an ordinary interplanetary voyage, apart from a full-blooded expedition out to take a planet to bits. Actually, one man could, as Miller suggested, do the job. It is only during the actual take-offs and landings that there is anything much to do, and at these moments it's impossible for more than one pair of hands to be on the controls. At least, it's highly inadvisable!

During all the days of the voyage, apart from the few hectic minutes at the beginning and end, there is practically nothing for the crew to do except take occasional observations and make the corresponding corrections. This would involve one man for only a small fraction of his time.

Moreover, spaceship machinery *must* be largely automatic, simply because things happen so quickly. Even in the first design for a lunar spaceship we have planned a practically automatic take-off, as you will see by the article and circuits on robot-control in the *Journal*. These circuits have been arranged so that by a selector system similar to that of an automatic telephone exchange, the correct tubes are picked out and fired in the right "staggered" sequence. Moreover, the arrangement will keep the ship on its course if it starts to "wobble" linear stability is given to a large extent by the axial spin and in addition we have incorporated the gyromechanism suggested by you some time back in a previous letter.

This "robot pilot" should take the ship safely away from the Earth without the interference of the crew. When free space is reached, it will be necessary to take observations, reduce them with luck, we could get the astronomers back on Earth to do this and then make the navigational corrections. Then, for all the good it could do, the crew might just as well go to sleep for the rest of the voyage. If anyone can think of a reason for keeping watch in space, I'd be glad to hear it.

I'm sending a copy of this *Journal* to Miller, so that he and de Camp can fight it out between them, but I'm hoping that these remarks will be of general interest to your readers, especially if anyone else joins in the scrap. Arthur C. Clarke, British Interplanetary Society, 8S Grays Inn Road, London, W. C. 1., England.

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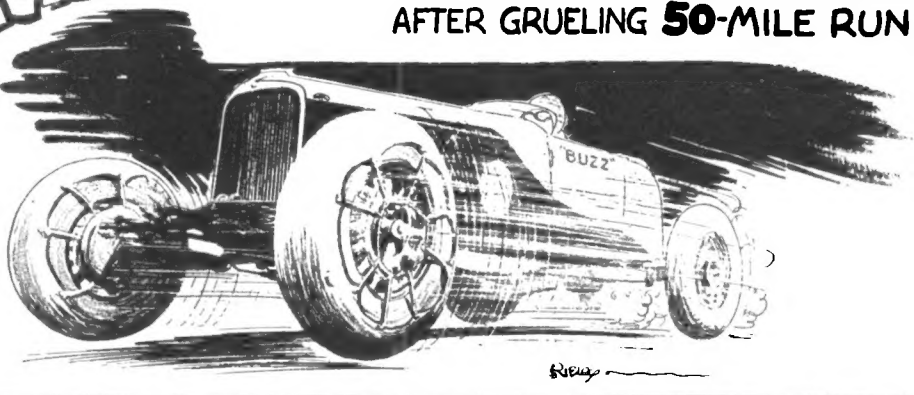

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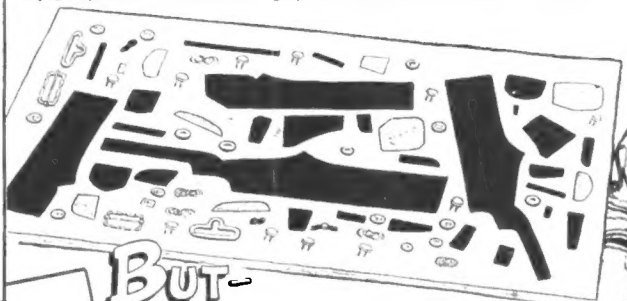

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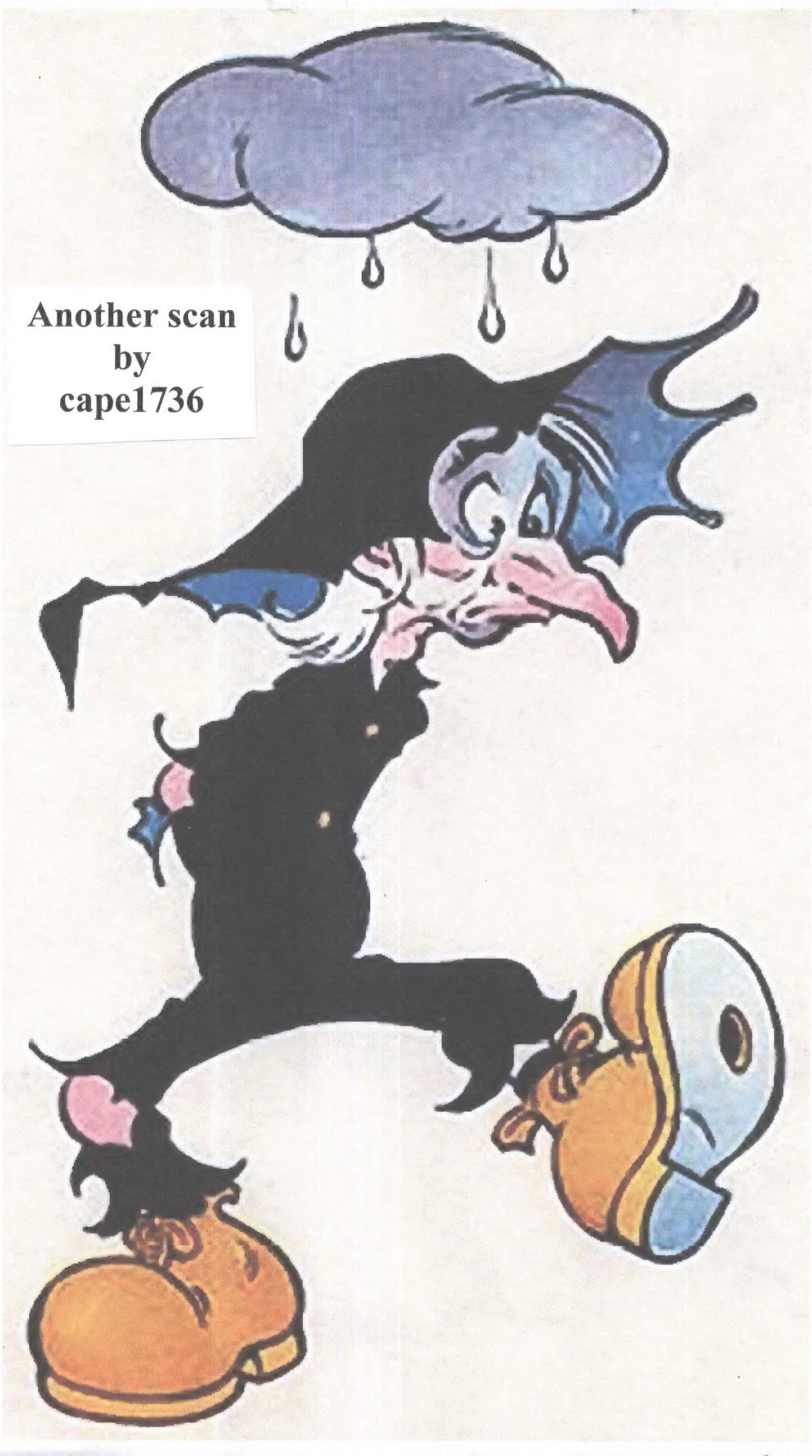
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